SCIENCE TODAY AND TOMORROW

Teachers' Edition

Science Around You

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Science Around You

Grade 2

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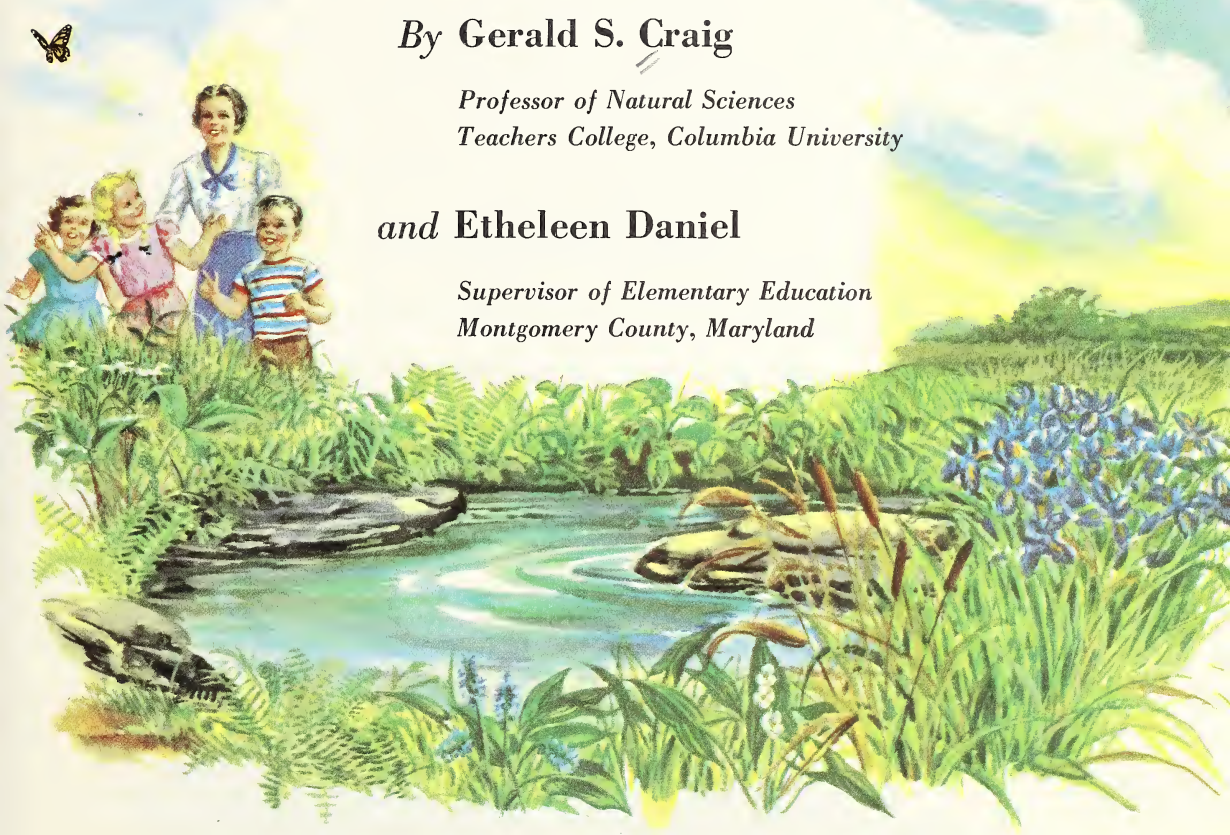

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SCIENCE TODAY AND TOMORROW

Science and You (Primer) · CRAIG-BRYAN

Science Near You · CRAIG-BRYAN

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Science Everywhere · CRAIG-LEMBACH

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A Teachers' Manual accompanies each book

Illustrations by CORINNE DILLON, WILLIAM BARTLETT, *and* MAURICE ROBERTSON

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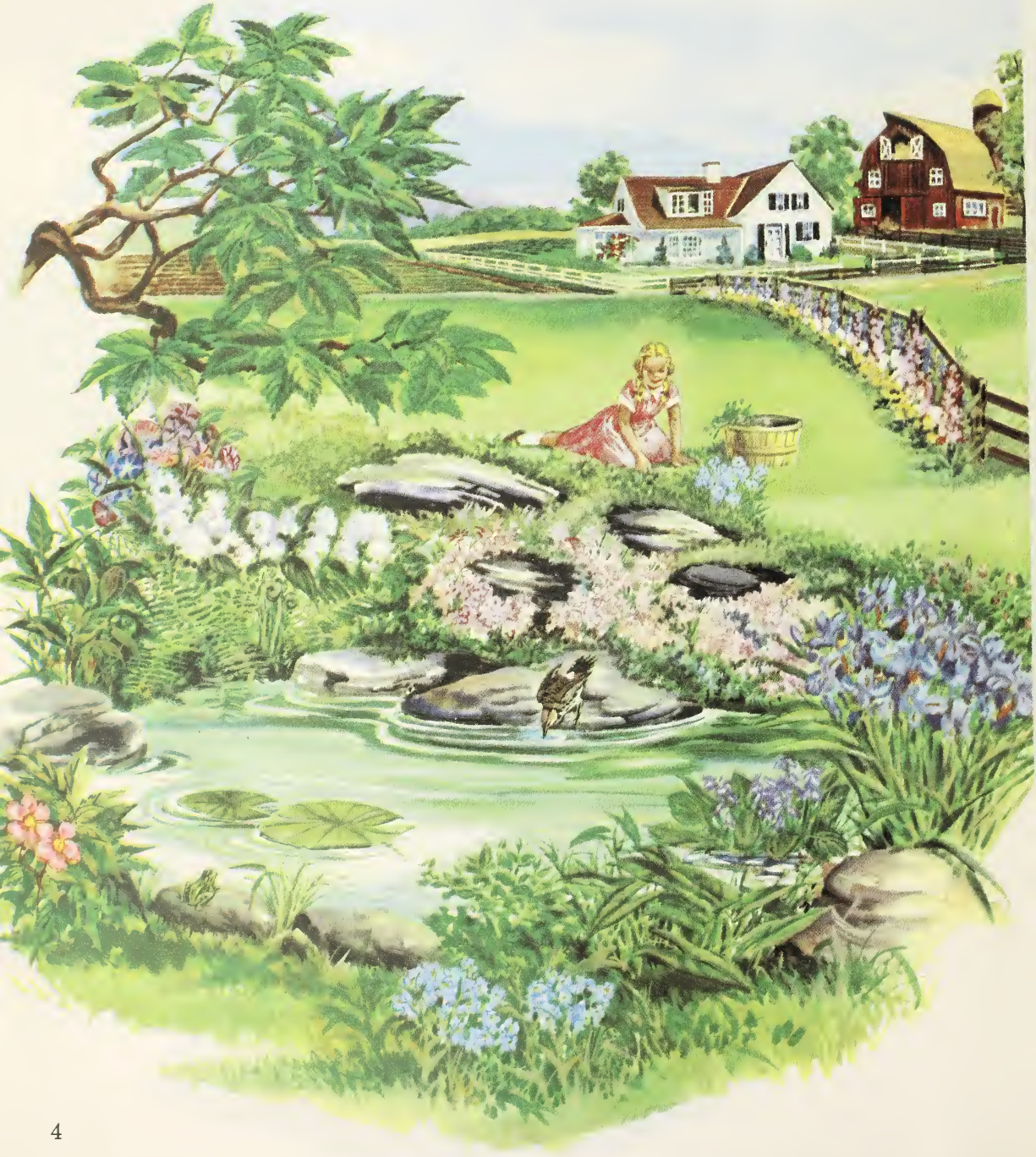
Summer



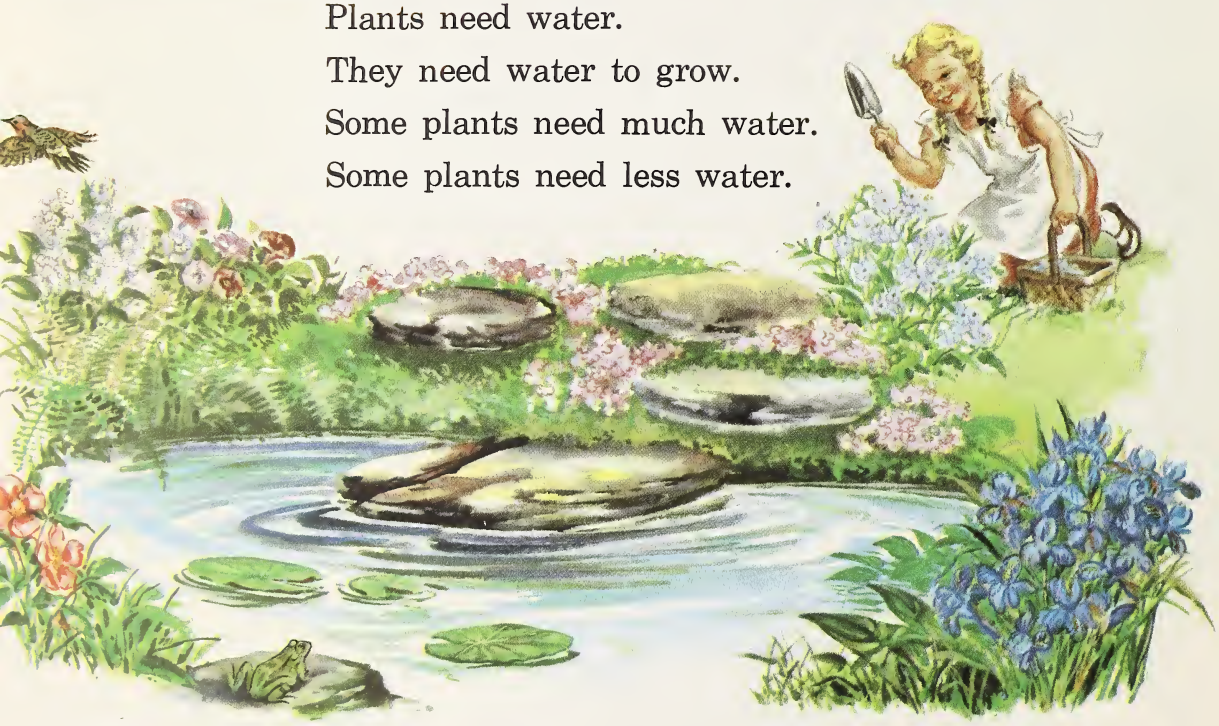
In the Summer

This is the way it looks where Mary lives.
This is the way it looks outdoors in the summer.
Many of the plants have flowers now.
Many animals are about in the summer.

How does it look in the summer around you ?

Water for Plants

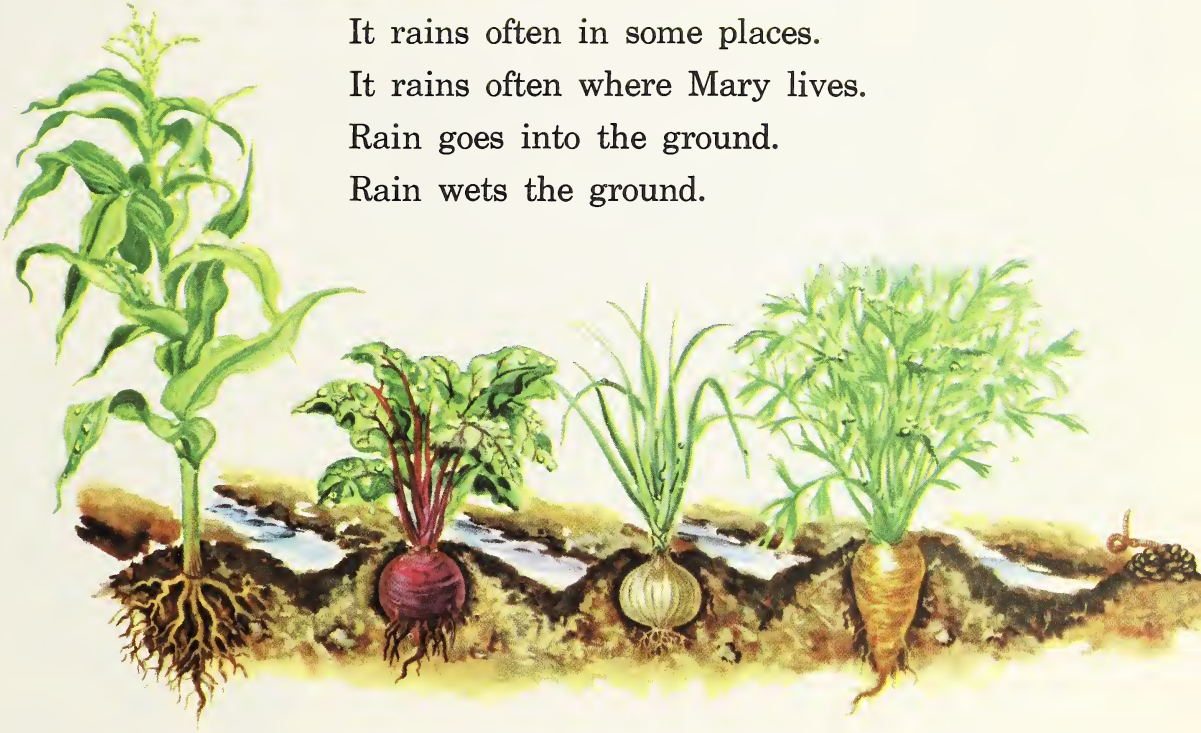
Plants need water.
They need water to grow.
Some plants need much water.
Some plants need less water.



Some plants grow near water.
Some plants grow in water.

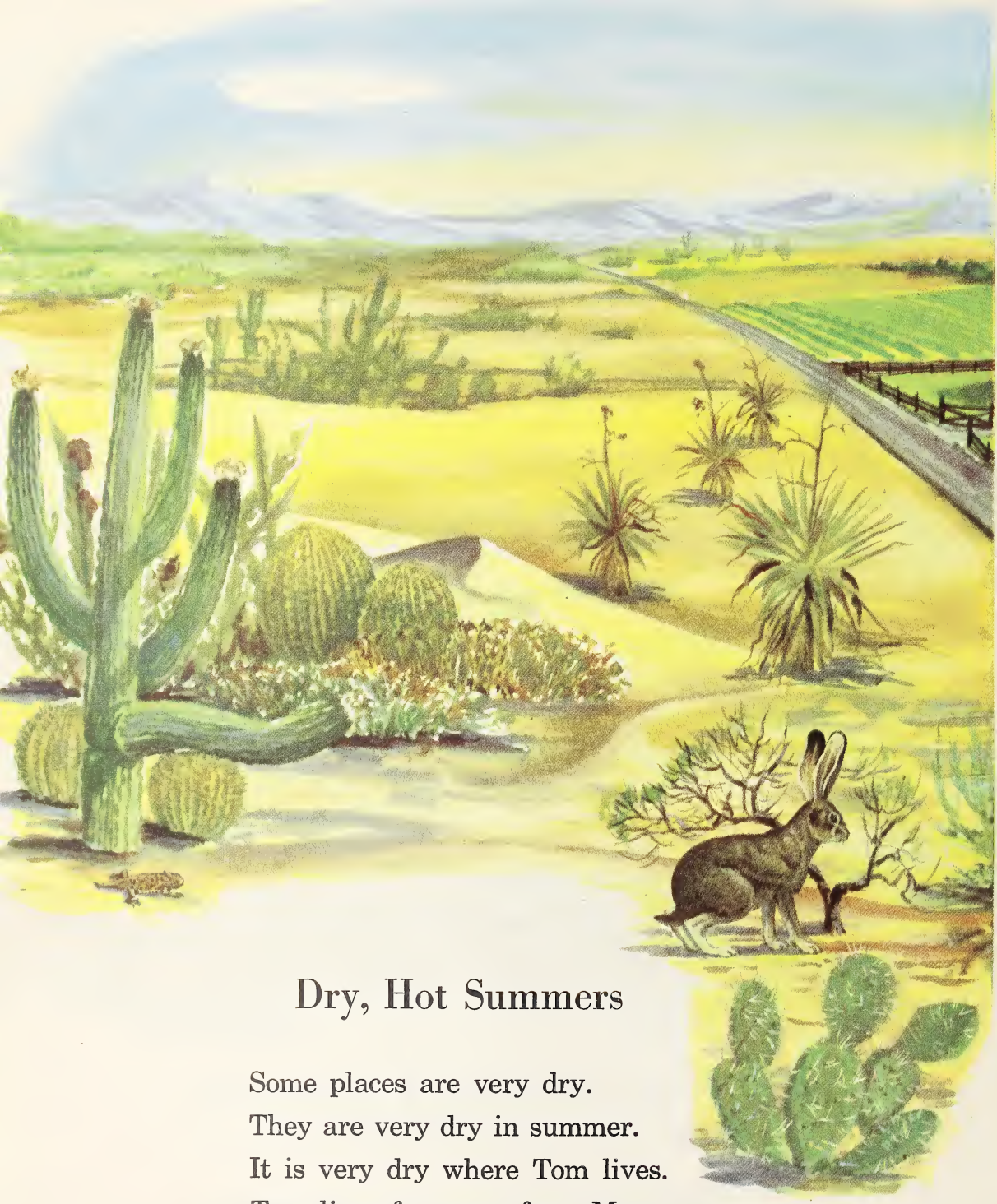
Do plants around you need much water?

It rains often in some places.
It rains often where Mary lives.
Rain goes into the ground.
Rain wets the ground.



Some of the water goes into the roots.
The root is part of the plant.

How do plants around you get water?



Dry, Hot Summers

Some places are very dry.
They are very dry in summer.
It is very dry where Tom lives.
Tom lives far away from Mary.

The days are very, very hot.
Many days come and go without rain.
The plants in Tom's garden must have water.
They must have water if they are to grow.

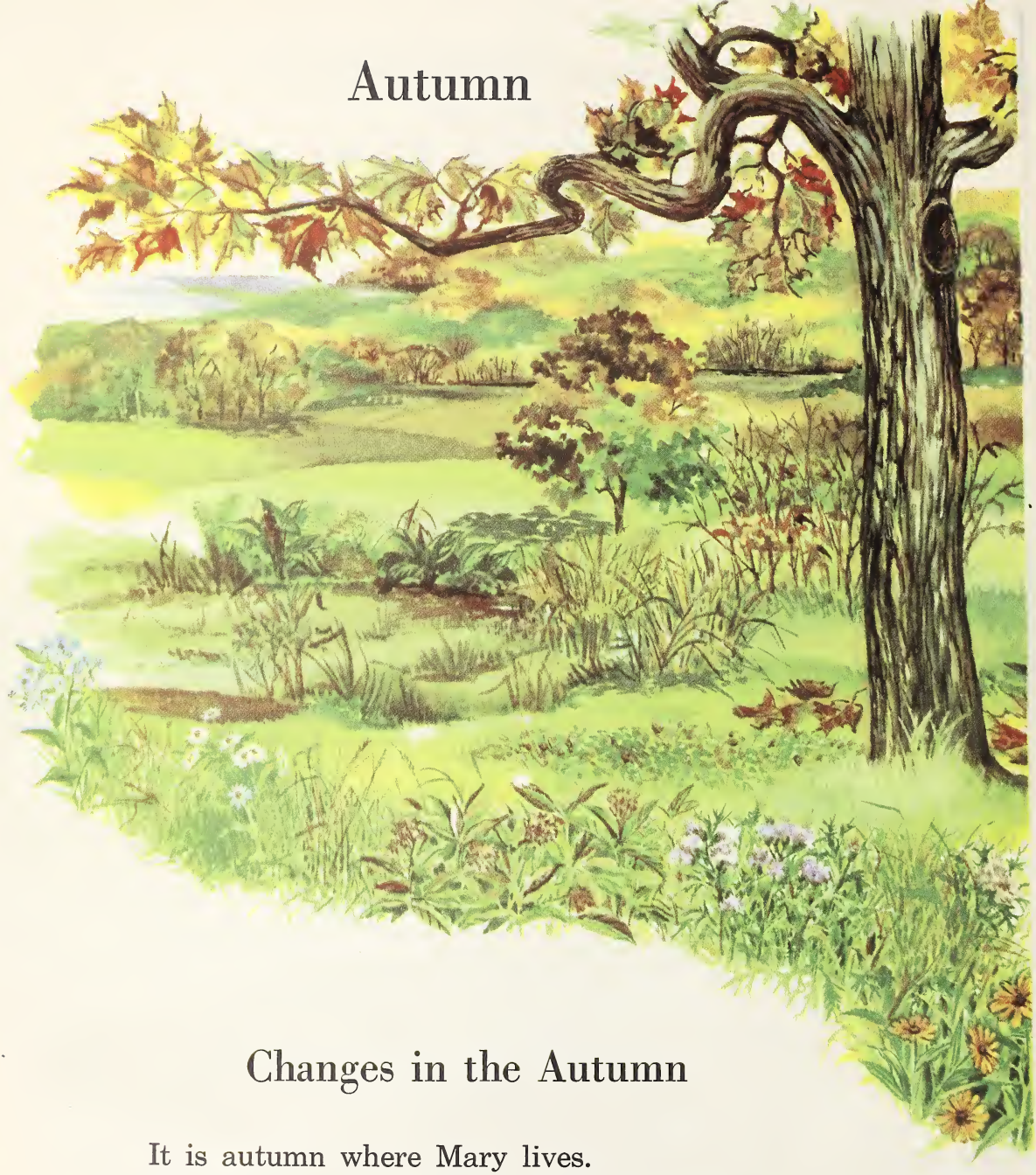
Water from Far Away

It is dry much of the time where Tom lives.
There is very little rain in this place.
The plants must have water to live.
Tom helps to get water to the plants.
He helps to make ditches near the plants.

The water goes into the ditches.
It comes from far away.
It comes from the snow far away.
It helps the plants to grow.

How does water get to plants near you?

Autumn



Changes in the Autumn

It is autumn where Mary lives.
The children and Miss Day go for a walk.
They go to the big woods and to the meadow.
They see how things change.

The leaves were green in the summer.
Now they are red and yellow and brown.
The leaves are falling to the ground.

"Let's take some leaves," said Mary.
"Take them from the ground," said Miss Day.
"Let the leaves stay on the tree.
They belong to the tree.
The leaves help the tree.
They will fall when they are ready.
Leaves change in the autumn."

Leaf buds

Leaf Buds in the Autumn

The children see the leaf buds.
The leaf buds are small and hard now.
They will open in the spring.
New leaves will grow out of the leaf buds.
They will grow out of them in the spring.

Leaf buds

The leaf buds belong to the tree.
The children will look at them outdoors.
They will look at them often.
They will not take them from the tree.

Where can you look for leaf buds?

Seeds in the Autumn

"Some plants have seeds now," said Bob.
"May we take some seeds with us?"

"The seeds fall to the ground," said Miss Day.
"Many of them will grow into new plants.
They will grow into new plants in the spring."

"Let's leave the seeds here," said Mary.
"They belong outdoors.
We can look at our plants outdoors.
We can look at them all through the winter."

"Our meadow will need new plants," said Bob.
"It will need new plants in the spring."

Seeds Are Moved About

Many, many seeds fall to the ground.
But many seeds cannot grow in one place.
Some of them are moved away.

Seeds are moved about in many ways.
The wind moves some seeds.
Animals move some seeds.
Water moves some seeds.
New plants may grow from seeds.
They will grow when spring comes.
They may grow far away.

Where can you look for seeds?
How do they get moved about?

Experiments with Seeds

Mary plants some seeds.
She plants them this way.
Will they grow well?

Bob plants some seeds.
He plants them this way.
Will they grow well?

Mary's seeds grow this way.
Are they growing well?

Bob's seeds grow this way.
Are they growing well?

Plant some seeds at school.
Plant them Bob's way.
Watch them grow.
Do your seeds grow well?

Animals Make Changes

"Here is a caterpillar," said Bob.
"Look how it eats and eats."

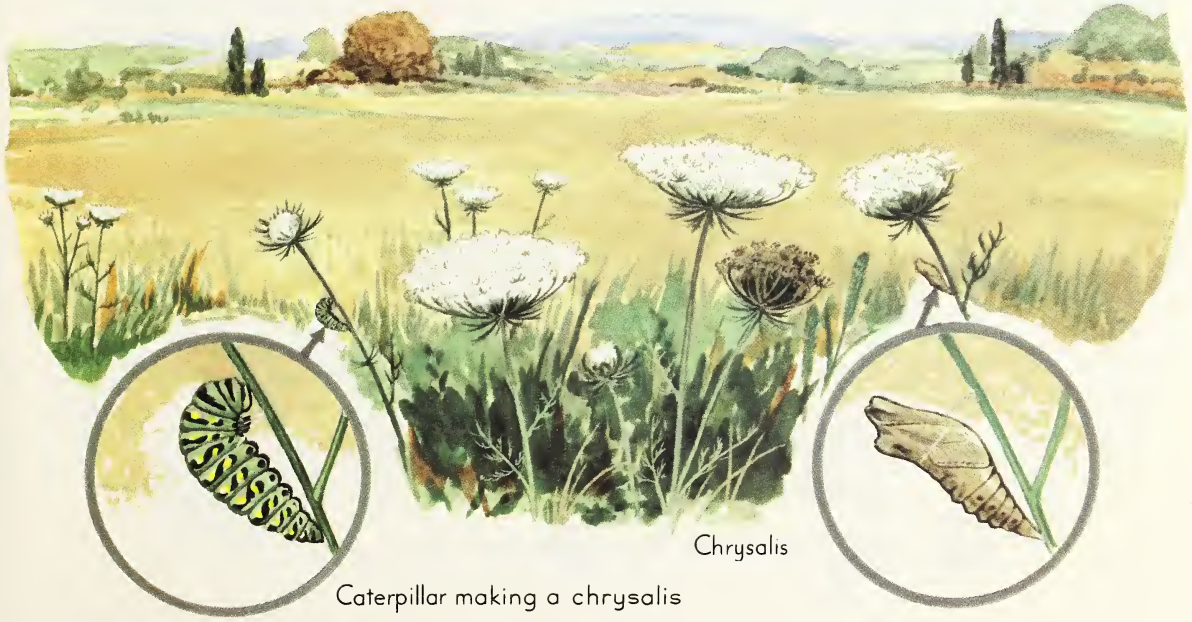
"Soon it will make a cover," said Miss Day.
"The caterpillar will make a cover all around it.
It will make a cover before winter comes.
A caterpillar makes changes in the autumn."

" Here is a caterpillar that has made changes.
It has a cover all around it," said Bob.
"A caterpillar made this butterfly chrysalis.
It is in the chrysalis now," said Miss Day.

" Let's take the butterfly chrysalis," said Bob.
" Oh, no," said Mary. " Our school is too warm.
The butterfly may come out too soon.
It may come out of the chrysalis too soon."
" It may come out in the winter," said Bob.

Butterfly

The children do not take the chrysalis.
They do not want the butterfly to come out too soon.
It is too cold for a butterfly in winter.
In the spring it will not be too cold.



Chrysalis

Caterpillar making a chrysalis

Birds in the Autumn

Many birds are around.
They do not make much noise.
They do not fly about much.

The birds lose some feathers.
They lose them in the autumn.
Their old feathers are falling out.
New feathers are growing in.

Many birds fly south in the autumn.
Some of them will fly south now.
Some will fly south tomorrow.
Some will fly south later.

Now the birds are eating and eating.
They eat in little flocks near the ground.
They fly around and around.
Then the flock comes down.
The flock comes down to eat again.
Soon it will fly away.

Use Old Leaves

Take a walk in the woods in the autumn.
The leaves make a very good carpet.
Look at the carpet of leaves.
Look under the colored leaves.
Are they breaking into little parts?

Use your old leaves in the autumn.
Make a hole in the ground.
Make a hole for your leaves.
Then put the leaves into it.
The leaves will break up.
They will break into little parts.
The little parts help to make soil.
Leaves help to make good soil.

What Changes Do You See?

1. What changes do you see in the autumn?
Make a picture of the autumn.
Show the changes that you see around you.

2. Go for a walk in the autumn.
What birds do you see?
What sounds do they make?
Do they make much noise?
Do you see little flocks of birds?

3. Look at the carpet of leaves around you.
How do the leaves make good soil?

Air, Water, Weather

Air Around You

Air is over Tom's garden.
It is over the ditches.
It is around Tom.

Air is around you.
It is around other children.
Air is all around.

Air is over Betty's city.
It is over the trees.
It is over the streets.

Air goes up high over you.
It goes up high above the ground.
It goes up high above the clouds.
Clouds are in the air.

You are in the air all the time.
Air is around you all the time.
Air is over you all the time.

Dust in the Air

Is there dust in the air around you?
How does dust get into the air?

Betty sees dust in the air around her.
The dust is all around her.
She helps to clean the dust away.

Bill sees dust in the air, too.
The wind is blowing dust all around.
There is no grass to hold the soil.

Bill is walking on grass here.
The wind is blowing.
But the soil does not blow around.
There is little dust in the air.
Grass helps to hold the soil.
Grass helps the air to be clean.

Smoke in the Air

There is smoke above the city.
The smoke goes above the houses.
The smoke goes above the school.
Up, up, the smoke goes into the air.

The smoke makes the city dirty.
It makes the streets dirty.
It makes the houses dirty.
People must work to clean the city.
They must work to clean the school.
They must work to clean their homes.

Some day the city will not be so dirty.
There will not be so much smoke.
The people will have a clean city.

Water Goes into the Air

Bob put a little water into a glass.
He looked at the glass later.
The water was gone.

"Who poured the water out?" asked Bob.
"Did you pour it out, Miss Day?"

"No," said Miss Day, "I did not pour it out."
"I did not pour it out," said Mary.

"Let's do the experiment again," said Bob.
"Let's put some water in the glass."

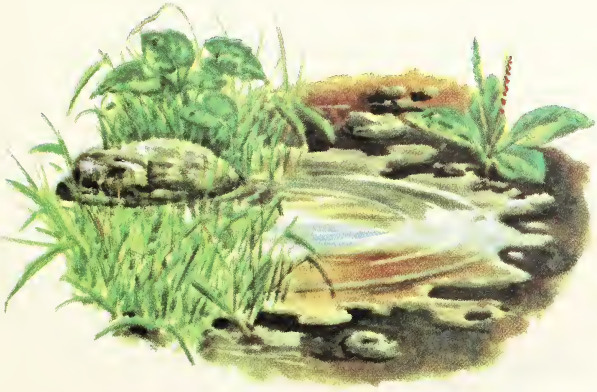
Bob looked at the glass later.
The water was gone.

"Maybe the glass leaks," said Mary.
"There are no holes in the glass," said Bob.
"Then it does not leak," said Mary.
"Where did the water go?" asked Bob.
"Did it go into the air?"

Water goes into the air.
Air is above the glass.
Air is all around the glass.

You cannot see the air.
You cannot see water in the air.
But air can hold water.
Water evaporates into the air.

Do you know where water evaporates?



There is water here

Now there is little water

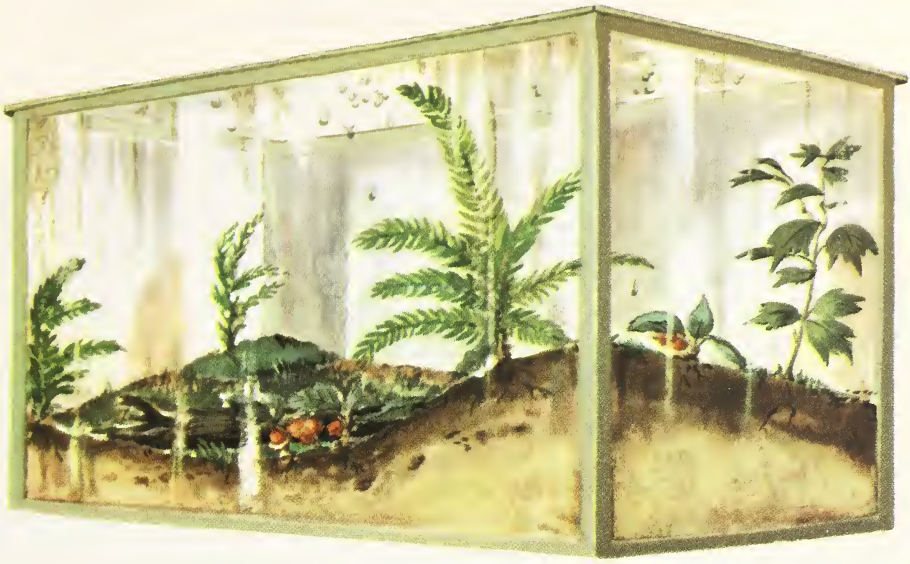
Water Comes out of the Air

The pitcher feels warm and dry.
Betty puts ice into the pitcher.
Soon it feels wet and cold.

Betty looks at the pitcher later.
There is water on the cold pitcher.
Where did the water come from?

The water came out of the air.
The air around the pitcher was warm.
The cold pitcher cooled the warm air.
Then water came out of the air.
It made tiny drops on the pitcher.

There is some water in the air all the time.
You cannot see it in the air.
But sometimes you can see water
that comes out of the air.



Betty is growing plants in a jar.
Water goes into the air from the soil.
Water goes into the air from the plants.

The air in the jar moves about.
Sometimes it is cooled at the top of the jar.
Then drops of water come out of the air.
The water falls down on the soil and plants.
The water will go into the air again.
It will be cooled at the top of the jar.
Then drops of water will come out of the air.
The water is used over and over again.

Betty said, "It rains in my jar.
The top of my jar is something like a cloud."

Clouds in the Air

Clouds are in the air.
Some clouds are high in the air.

Some clouds are low in the air.
Do you see clouds in the sky now?

Rain from the Air

Now there are dark clouds in the sky.
Rain is falling, falling, falling.

Sometimes there is much water in the air.
There is more water than the air can hold.
Then the water comes out of the air.
It drops from the clouds.
The water drops down, down, down.
The water drops to the ground.
Then we have rain.

Snow from the Air

There is some water in the air all the time.
You see it as clouds. You see it as rain.
The rain comes out of the air.

Snow comes from the air, too.
There is water that you cannot see in the air.
This water sometimes freezes into snow.
The air is cold when it snows.

Warm Air and Cold Air

Sometimes the air around you changes.
Air may change from cool to cold.
It may change from warm to hot.

A thermometer tells you something about the air.
A thermometer tells you how warm the air is.
It tells you how cold the air is.

Thermometers help many people.
They help you to know how cold it is.
They help you to know how warm it is.

How do you see thermometers used?

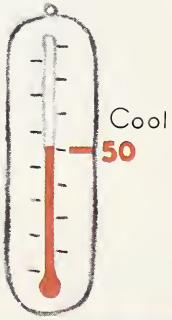
Watch the Weather About You

What kind of weather do you have now?
Make a record of your weather.
Make a record of each day's weather.
Make a picture record for a few days.
You may use these pictures to help you.

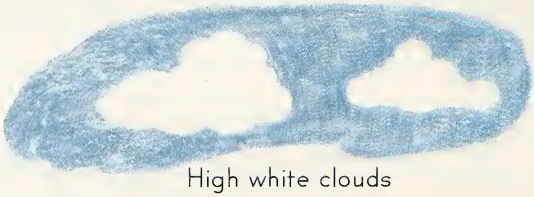
Little wind

Much wind

Tell about the wind.
Is the wind blowing a little?
Is it blowing much?

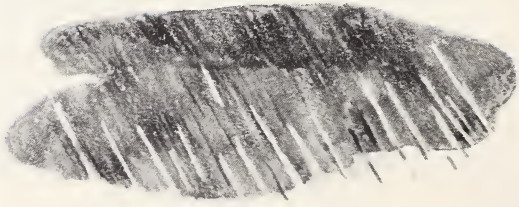


Tell how the air feels.
How warm does the air feel?
How hot does the air feel?
How cool does the air feel?
How cold does the air feel?



High white clouds

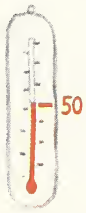
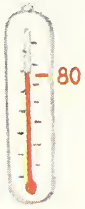
Tell about the clouds.
Do you see clouds?
Do you see white clouds?
Do you see rain clouds?
Do the clouds move fast?



Low rain cloud

Make a Weather Record

Weather Record

	The Sky		The Air		The Wind	
Day	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
Monday						

You can make a weather record.
You can watch the weather change.
It may change during the day.
It may change from day to day.
In some places it may change quickly.

There are many kinds of weather.
What kinds of weather do you have?
Does it change during the day?
Does it change from day to day?

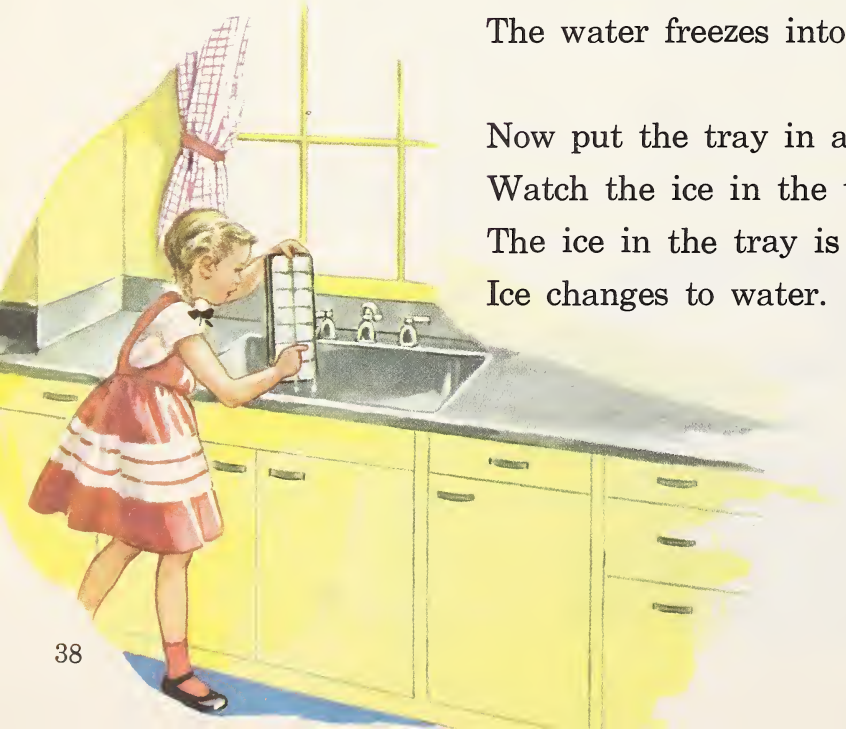
Ice and Snow Melt

The sun is shining.
The air feels warm.
The ground is warm.

Ice and snow melt.
They melt when it is warm.
Ice changes to water.
Snow changes to water.
Ice and snow melt.

Do this experiment.
Put water into a tray.
Put the tray in a cold place.
The water in the tray changes to ice.
The water freezes into ice.

Now put the tray in a warm place.
Watch the ice in the tray melt.
The ice in the tray is cold and wet.
Ice changes to water.



What Is in the Air?

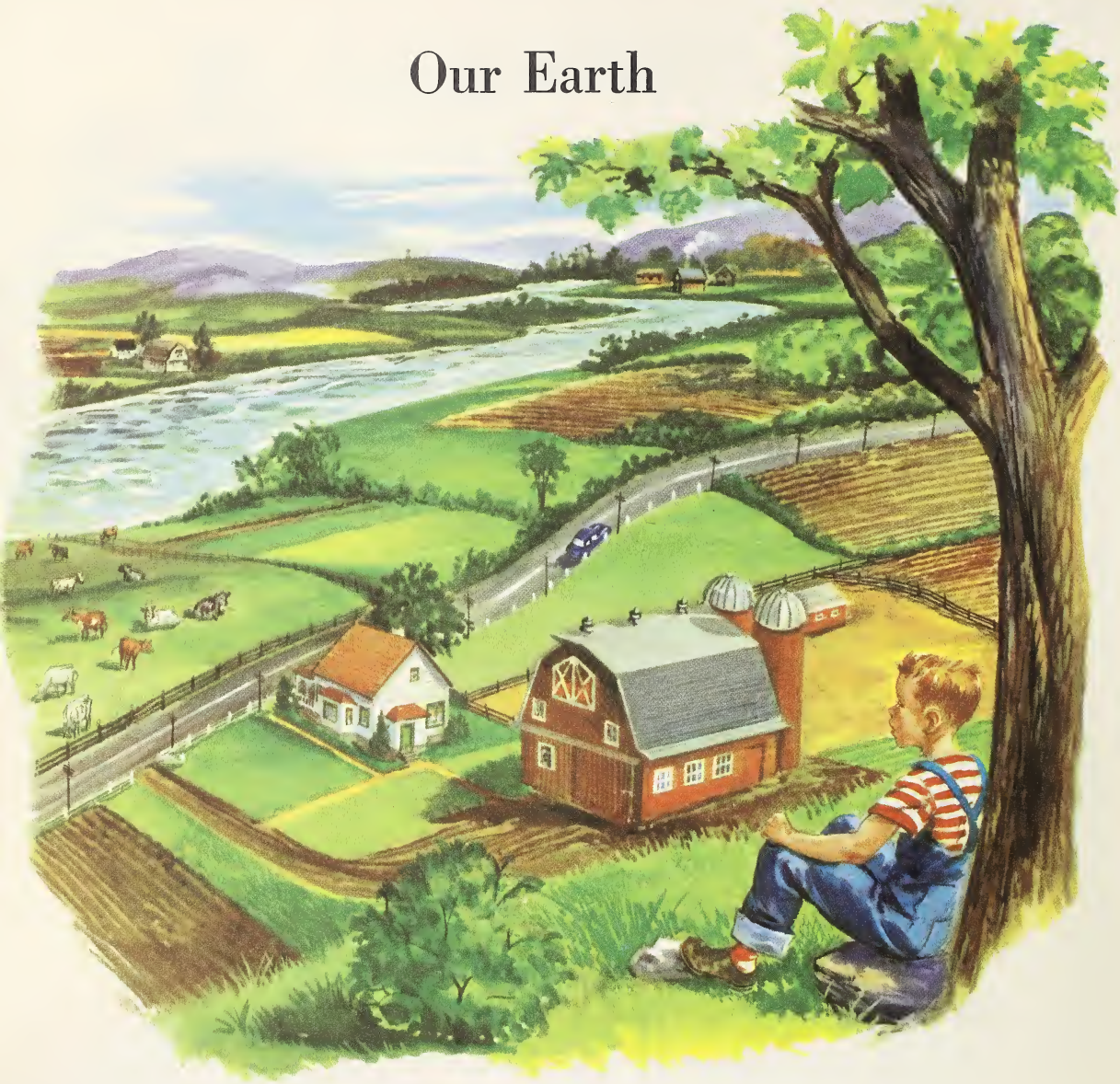
1. Can you grow plants in a jar?
How is the top of your jar like a cloud?

2. Put one glass of water in each of these.
Where does water evaporate fast?
Where does water evaporate slowly?
Where does the water go?

3. Does the cup on the table leak?
How does the water get on the cup?
Where does the water come from?

4. What do you see in the air around you?
Do you see clouds in the air?
Do you see dust in the air?
Do you see smoke in the air?

Our Earth



Our Large Earth

Jim looks around him.
He sees his father's farm.
He sees the cows.
They are near the river.

Jim sees the hills.
Some are near the river.
Some hills are far away.
Jim sees other farms, too.

Betty looks around her.
This is what she sees.
Betty sees trees.
The trees are in the park.
Betty sees cars.
They are near the lake.
She sees boats on the lake.
She sees part of the city.

Jim's farm is a part of the earth.
Betty's city is a part of the earth.
Jim's farm is only a tiny part of the earth.
Betty's city is only a tiny part of the earth.
There are many farms on the earth.
There are many farms and cities on the earth.
There are many people on the earth.
We all live on the earth.

The ground is part of the earth.
The ocean is part of the earth.
The air belongs to the earth.
The clouds belong to the earth.

Our Earth Is Round

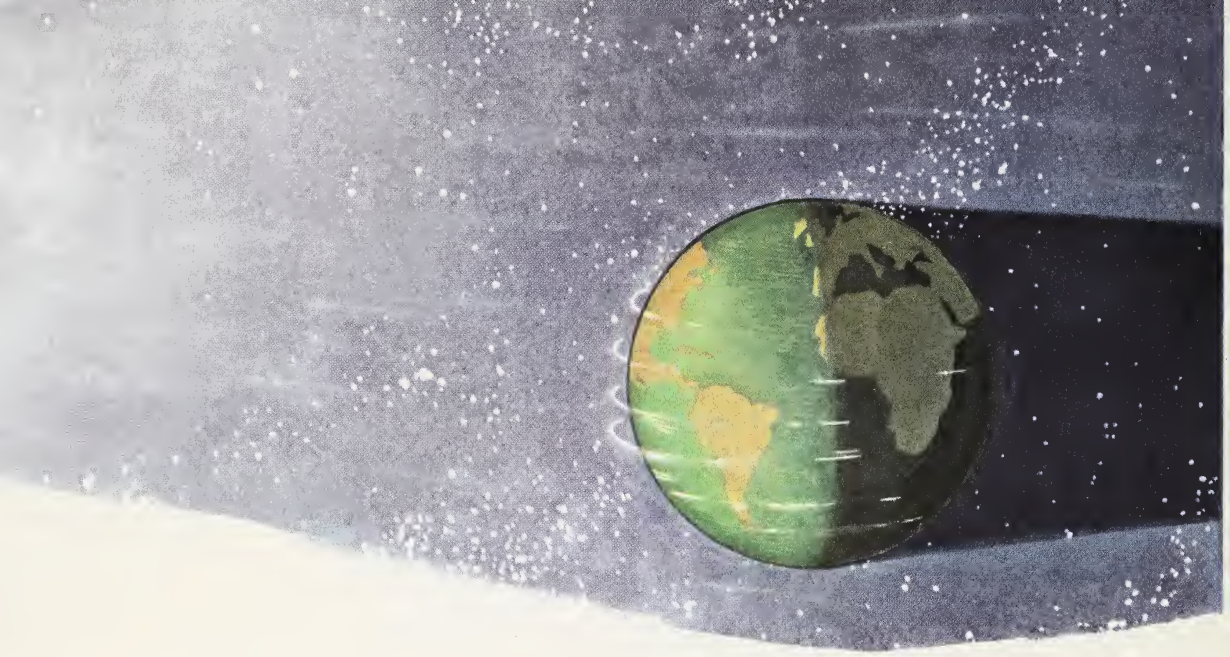
Betty lived far, far away.
Now she lives in a big city.
She came from far away to the city.

It took Betty a long time to get to the city.
She rode on a train part of the way.
She rode on a ship part of the way.
Then she rode in an airplane.
Then Betty rode in a car.
But she did not leave our big, round earth.

Our earth is round.
It is like a very big ball.

Ships go around the earth.
Ships go on the waters of the earth.
Airplanes fly around the earth.
They fly in the air of the earth.
You may go around the earth sometime.
You may go in a ship or an airplane.

There are many, many people on the earth.
We all live on the big, round earth.



Our Earth Moves

Our earth is a big, moving ball.
It is moving all the time.
It never stops moving.

It moves all day. It moves all night.
The earth takes you with it all the time.
It gives you a ride all the time.
You ride on the earth all the time.

The earth moves very fast.
The earth moves faster than ships.
The earth moves faster than trains.
The earth moves faster than airplanes.

You do not feel the earth moving.
It is a very, very big ball.
You cannot feel it moving.
It keeps on moving all the time.

A train starts and stops.
It starts and stops many times.
Sometimes it moves fast.
Sometimes it moves slowly.
It starts and stops again and again.

But the earth keeps on moving.
It moves fast all the time.
It never, never stops.
It keeps on moving all the time.

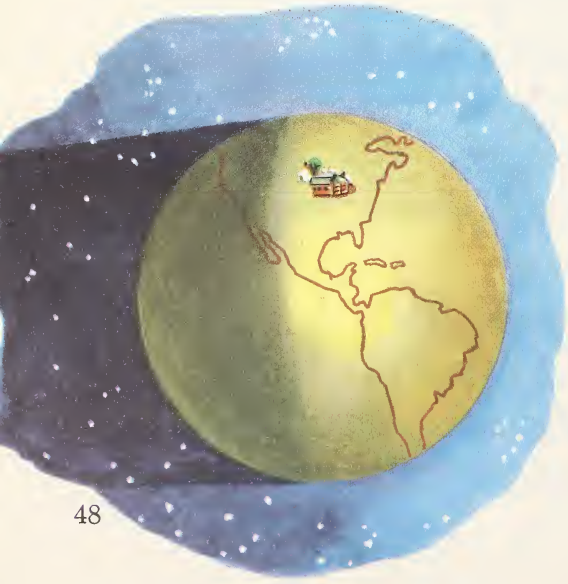
Night and Day on Our Earth

The earth moves all the time.
Jim's farm moves with the earth.
Now Jim's farm is in the sunlight.
The sun is shining on his farm.
It is daytime. Jim is at school.

Now it is night at Jim's farm.
The sun is not shining on his farm.
It is dark around Jim's farm.
Jim is at home. He is sleeping.

The earth is moving all the time.
The sun is shining all the time.
The sun is shining somewhere at night.
It is shining somewhere on the earth.

Jim's farm, day



Jims farm, night

Sunlight and Shadows

Do this on a sunny day.
Hold your book in the sunshine.
Does the sunlight go through your book?
Do you see the shadow of the book?

Now use some window glass.
Hold the glass in the sunshine.
Does the glass stop the sunlight?
Does the sunlight go through the glass?

The book stops the sunlight.
The book makes a shadow.
The glass does not stop the sunlight.
It does not make a shadow.

Making Shadows

The picture shows how to make a shadow.
Where should you be to make a shadow?
Where should the light be?
What makes the shadow?

Mary stops the light.
She makes the shadow.

Thinking About Our Earth

What stops the sunlight?
What makes the shadows?

Go to any place where you can see far away.
What do you see on part of our earth?
What do you see very near you?
What do you see far, far away?
Can you make a picture of what you see?

How do you know that the earth is big?
How do you know that it is moving all the time?

The Sky

The Sun Is Far Away

The sun is far away in the sky.
The sun is far, far away.
It is far away from our earth.
The sun is not a part of the earth.

The Sun Is Hot

The sun is very, very hot.
It is a hot ball far, far away.
It is so hot that it heats the earth.
It is so hot that light comes from it.
The sun lights the earth.
It heats the earth, too.
The sun heats and lights the earth.

The sun is hotter than a candle.
It is hotter than any stove.
It is hotter than many, many stoves.
It is hotter than all candles and all stoves.
The sun is hotter than any fire on earth.

The Morning Sun

It is morning where Mary lives.
It is morning on the farm.
Mary sees the sun in the east.
She sees it over the hill.
The sun looks small to Mary.
It looks smaller than the hill.
It looks smaller than the house.
It looks smaller than the trees.

But is the sun small?
Is it as small as it looks to Mary?

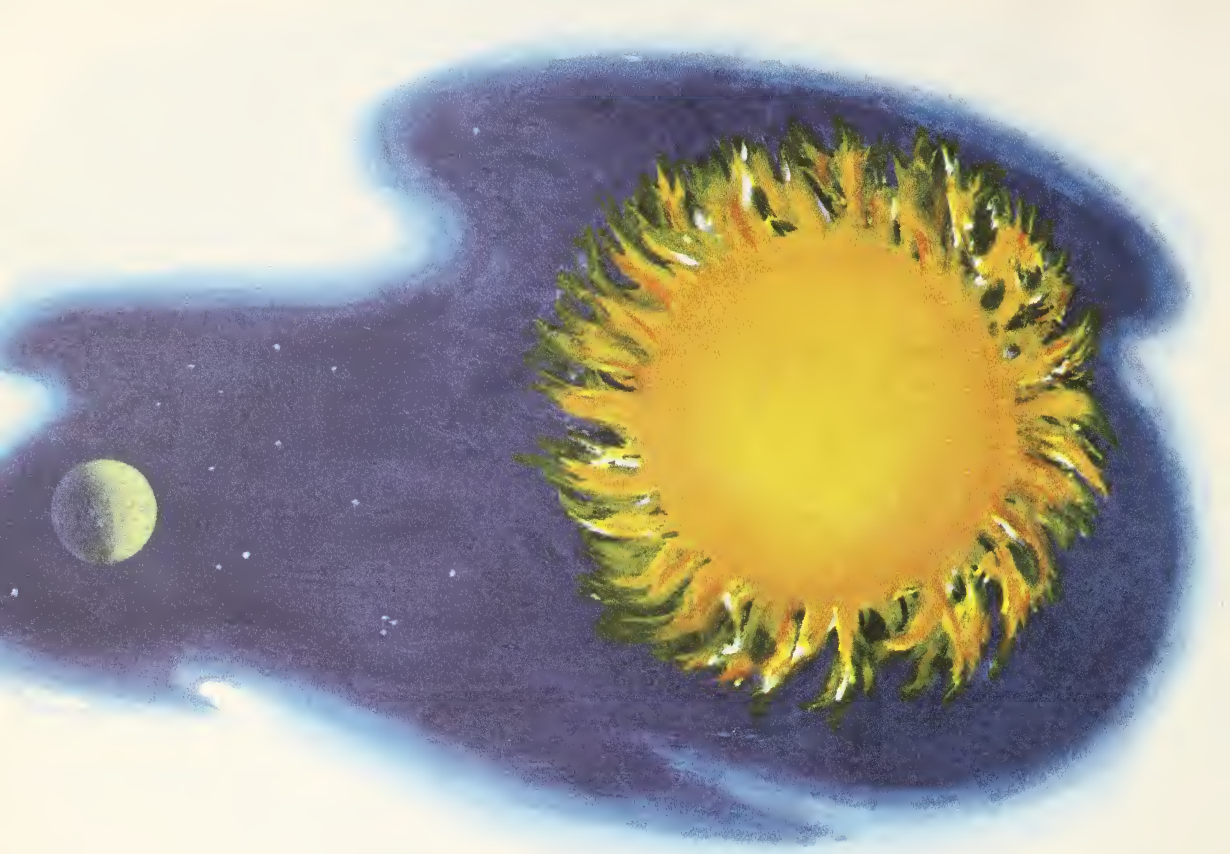
Watch the sun in the morning.
Watch the sun in the east.

The Afternoon Sun

It is afternoon on the farm.
Mary sees the sun in the west.
It is not back of the hill now.
It is back of the house.
The sun looks small to Mary.
It looks smaller than the house.
It looks smaller than the trees.

But is the sun small?
Is it as small as it looks to Mary?

Look at the sun in the afternoon.
Where do you see it in the afternoon?
Watch the sun in the west.



The Sun Is Large

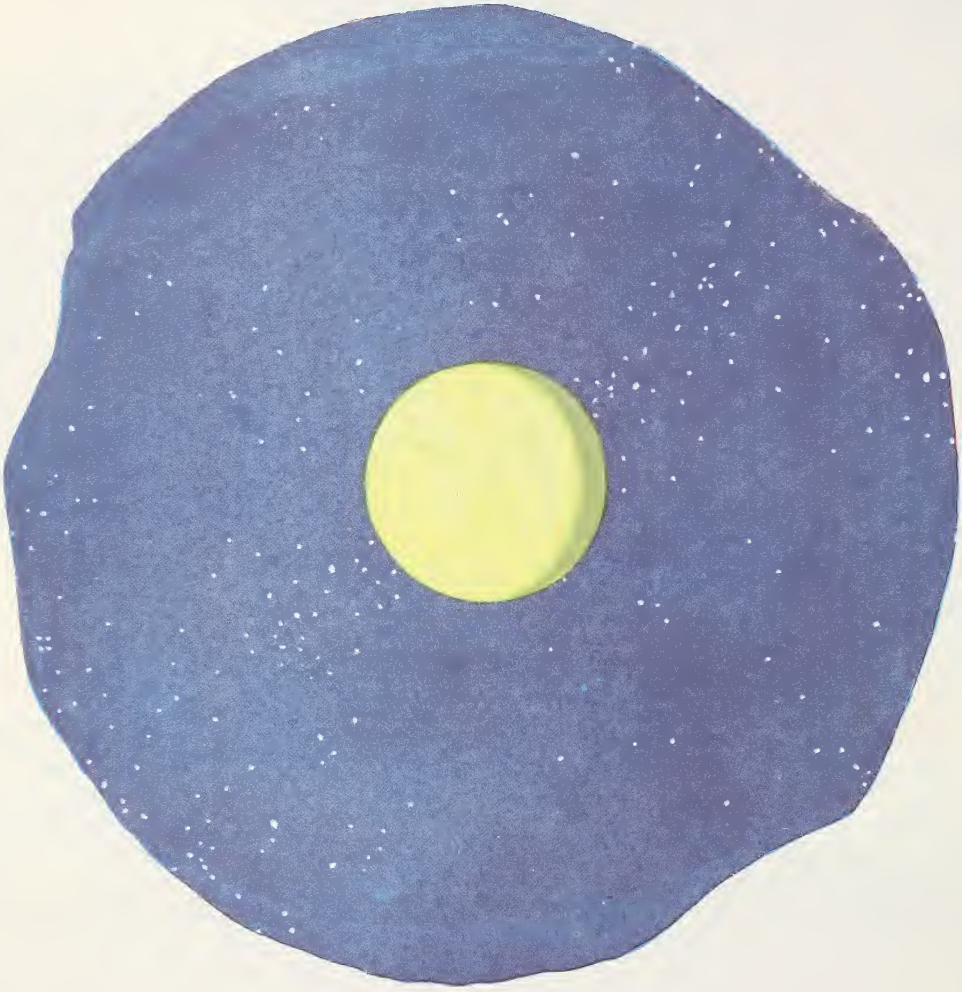
The sun is not small.
The sun is very large.
It is larger than many farms.
It is larger than many parks.
It is larger than many lakes.
It is larger than many cities.
The sun is larger than the moon.
It is larger than the big earth.
It is larger than many big earths.

The Sun Is Shining All the Time

Mary is going to school. It is cloudy.
She does not see the sun shining.
But the sun is shining.
It is shining on cloudy days.
It is shining above the clouds.
It is shining on sunny days.

Mary hears an airplane in the cloudy sky.
But she cannot see the airplane.
It is flying high above the clouds.
It is in the sunshine above the clouds.
The sun is shining all the time.

The Night Sky



The moon is like a large ball.
But the moon is smaller than the earth.
It is much smaller than the sun.

Sometimes the moon is in the night sky.
Sometimes it makes a bright light in the sky.

Sometimes the moon is not in the night sky.
Then the night is dark, without moonlight.

Sometimes the moon is in the day sky.
But it does not look bright in the daytime.
The moon is not as bright as the sun.
The sun is very, very bright.

Clouds in the Sky

Watch the sky above you.
Do you see clouds?

Some clouds are light and fluffy.
They are high in the air.
Sometimes they are tiny.

Do you see tiny fluffy clouds in the sky?
Do you see these clouds moving?

Some clouds are big and white.
Sometimes they are high in the air.
Some clouds are big and dark.
The dark clouds are low in the air.

Watch the clouds change in the sky.
Sometimes they change very fast.
The wind blows the clouds about.
It blows the clouds about fast.

Low rain clouds

Watch the big dark clouds in the sky.
Watch them come faster and faster.
Here comes the rain now.
The rain comes from the big dark clouds.

Now the rain is over.
At last the big dark clouds are gone.
The clouds in the sky change.

Watching the Sky

Watch the clouds in the sky.
What changes in the clouds do you see?

What do you see in the sky?
Do you see tiny fluffy clouds?
Do you see big white clouds?
Do you see rain clouds?
Are the clouds high or low?

Make a picture of the sky that you see.

Winter

Cold Winter Days

It is winter now where Mary lives.
Some places are very cold in winter.
It is cold in winter where Mary lives.

Mary and the other children look for animals.
They are at the brook near the big woods.
They see some animals moving about.

What animals do you see in winter?
Is it cold in winter where you live?

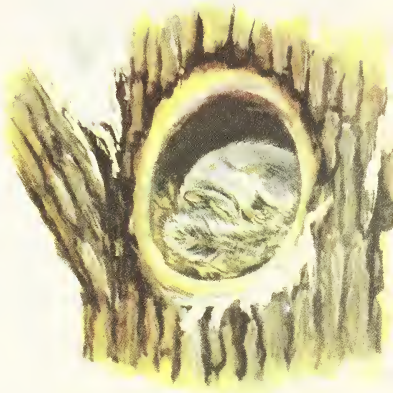
Animals in the Winter

Some animals stay around all winter.
They look and look for food.
The animals find seeds and nuts to eat.

In autumn some animals lose their old coats.
They grow new coats of hair or fur.
They grow new coats of hair or fur in autumn.
The new coats of hair and fur are warm.
The hair and fur keep the animals warm.

Squirrels are around in winter.
The squirrels eat nuts and seeds.
They eat nuts and seeds they have stored.
They eat food when they can find it.

Sometimes squirrels have places to stay.
They stay in these places on cold days.
They do not eat and run around.
They do not hear noises. They do not see.



You may think the squirrels are sleeping.
You may think they are dead.
But they are not sleeping as you sleep.
They are not dead. They are alive.
The squirrels hibernate.

Some other animals live like the squirrels.
They find places to stay on cold days.
On warm, sunny days they run about.
On warm, sunny days they look for food.
But they hibernate when it is very cold.

Some Animals Hibernate All Winter

Some animals hibernate all winter.
They stay below the frozen ground.
They do not eat. They do not see.
They do not run about on sunny days.
They find a place out of the cold wind.
Here they stay all winter.

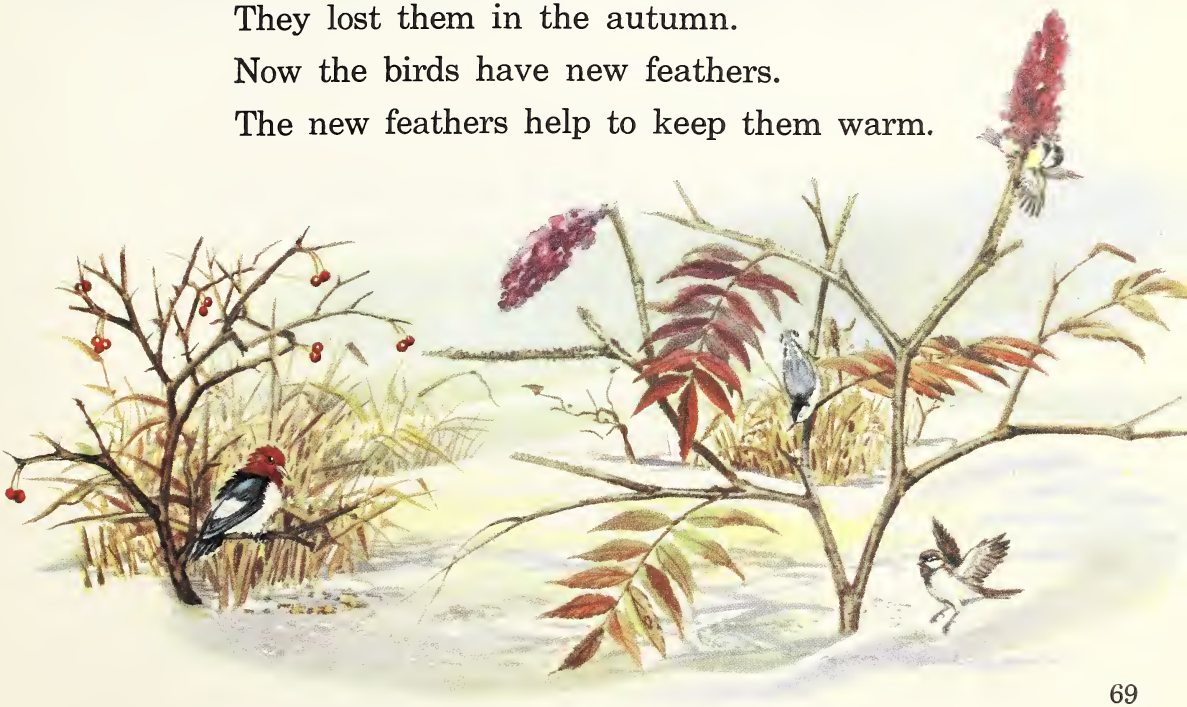
Frogs hibernate all winter.
They stay in the ground near the pond.
Here they are safe from cold winds.
Water in the ground may freeze.
But these animals do not freeze.
They are safe below the frozen ground.
They are safe all the winter.

Do you know any animals that hibernate?

Birds in Winter

Mary sees some other animals.
Some of these animals are birds.
Now there are some new birds.
They were not here last summer.
They were far away from where Mary lives.
They came here from much colder places.
They came from the north.
They will go back in the spring.

The birds fluff and fluff their feathers.
This makes the birds look big and round.
This helps to keep them warm.
The birds lost some of their feathers.
They lost them in the autumn.
Now the birds have new feathers.
The new feathers help to keep them warm.



Some Plants Live Through the Winter

Autumn

Winter

In autumn the grass changes where Mary lives.
Some of it changes from green to brown.

In the winter some of the grass looks dead.
The grass is brown and dry.
But the grass is not all dead.
The leaves above the ground are dead.
But the roots of the grass are alive.
The roots live through the winter.
They live under the ground.

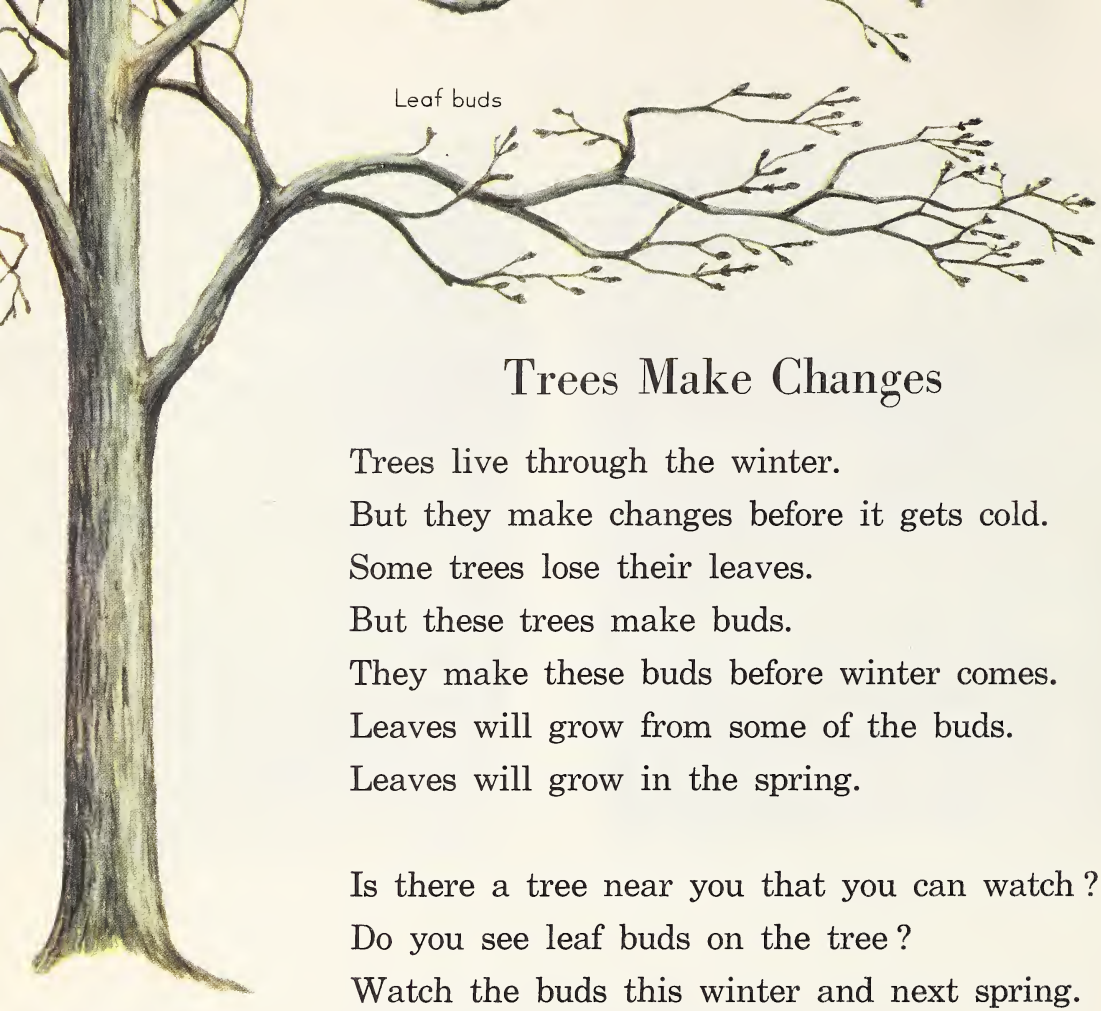
Spring

Summer

In the spring the grass will grow.
The roots will grow and grow.
The leaves will grow, too.
The grass will get green again.

What color is your grass in the winter?
What color is your grass in the summer?
Does the color of your grass change?

What other plants live through the year?



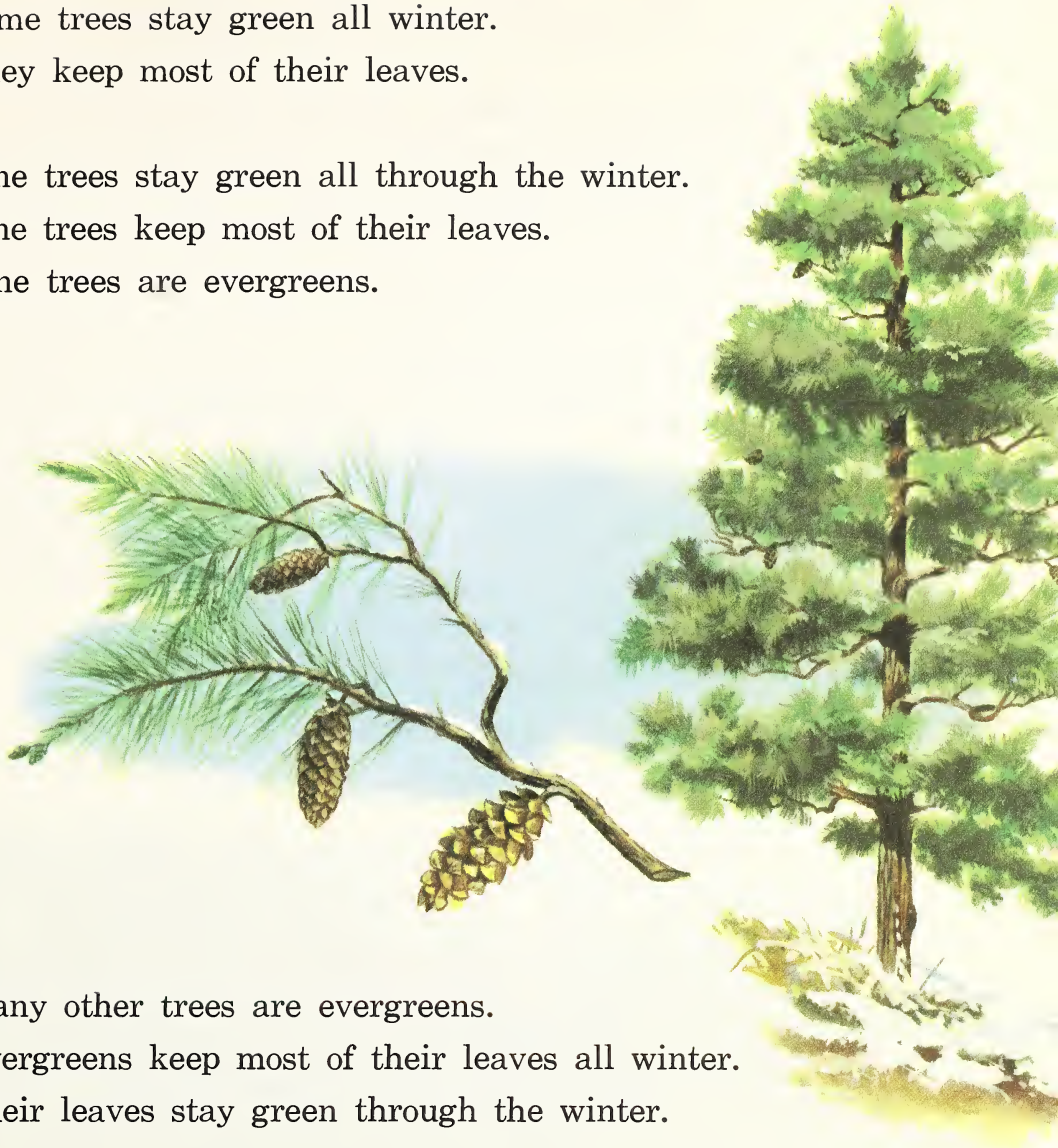
Trees Make Changes

Trees live through the winter.
But they make changes before it gets cold.
Some trees lose their leaves.
But these trees make buds.
They make these buds before winter comes.
Leaves will grow from some of the buds.
Leaves will grow in the spring.

Is there a tree near you that you can watch?
Do you see leaf buds on the tree?
Watch the buds this winter and next spring.
Inside the buds are tiny leaves.
The leaves will grow next spring.

Some trees stay green all winter.
They keep most of their leaves.

Pine trees stay green all through the winter.
Pine trees keep most of their leaves.
Pine trees are evergreens.



Many other trees are evergreens.
Evergreens keep most of their leaves all winter.
Their leaves stay green through the winter.

Evergreens may lose some of their leaves.
But evergreens lose only a few leaves at a time.
They get a few new leaves at a time.

Do any trees near you stay green in winter?

Warm Winter Places

Some places are warm in winter.
They are warm in summer.
They are warm most of the time.

Sandy lives in a warm place.
Sandy has never seen snow.
Sometimes it may be cold where he lives.
It may be cold for a few days.
But it is like summer most of the time.

Sandy has green grass in the winter.
He has green grass all through the year.
Many other plants are green in the winter.
There are many flowers too.

Birds in Warm Winter Places

Sandy sees new birds in the winter.
They were not here last summer.
They came here from the north.
It is much colder there in the winter.
The birds fly south for the winter.
They will be warm in the south.
In the spring they will fly north.

Do you live in a place like Sandy's?
What birds have you seen?
Do they fly from north to south?
Do they fly back and forth?

What Changes Do You See in Winter?

What changes are here in the winter?

How do plants and animals change?

How do they change as it gets colder?

What changes do you see from autumn to winter?

This is Mary's place in the winter.
Is your place like Mary's?

This is Sandy's place in the winter.
Is your place like Sandy's?

Do you live in a place of many changes?
Do you live in a place of few changes?

Sounds Around You

You Hear Sounds

Beat the drum. Beat the drum hard.
Put your finger on the drum. Feel the drum.
What do you feel with your finger?
Do you feel the top of your drum moving?

Put a little sand on the top of the drum.
Beat the drum again and again.
What does the sand do when you beat the drum?
The sand moves up and down, up and down.
The drum makes the sand move up and down.

Strike the drum again and again.
Hear the sound as you strike the drum.
The sound comes to your ears through the air.
You hear the sound.

Sound Goes into the Air

Let the spoon swing back and forth.
Swing the string and spoon many times.
Now let the spoon strike the table.
The spoon moves when it strikes the table.
Does it make a soft sound? Do this again.

The sound goes into the air. It comes to you.
It goes into the air all around you.

Now put one finger in each ear.
Swing the spoon and string back and forth.
Let the spoon strike the table.
What do you hear? Do this again.
Do you hear a louder sound?
Does it sound like a bell to you?

The spoon moves when it strikes the table.
More sound goes through the string to your ears.
Do this experiment again and again.

Sound Goes Through the Air

Listen to the clock ticking.
Is the ticking a soft sound?
Is the ticking a loud sound?

Sounds come to you through the air.
They go through the air all around you.

Put one end of the stick to your ear.
Put the other end of the stick on the clock.
What do you hear at the end of the stick?
How does the clock sound to you now?
Is the ticking sound loud or soft?
Can you hear the clock better through the stick?
The sounds go through the stick to your ear.
You hear louder sounds through the stick.

Some Things Vibrate

Strike the cymbals together.
Strike the cymbals together hard.
Do the cymbals make a loud sound?
Feel one cymbal quickly. What do you feel?
You feel the cymbal moving back and forth.
When things move back and forth, they vibrate.
Do you feel the cymbal vibrate?

You hear a sound when something vibrates.
What other things do you know that vibrate?

Push the button. The bell rings.
Push the button again.
Feel the bell as it is ringing. Is it moving?
How did the bell make your finger feel?
The bell is moving back and forth.
When things move back and forth, they vibrate.
You hear the bell when it vibrates.

Sounds out of Doors

Clinkety-clank ! Clinkety-clank !
How many sounds in the city do you know ?
Bells ring. Children call. Trucks roll by.
Many people think our cities are too noisy.
They do not like to hear so much noise.
Some day our cities will be better.
Some day our cities may have less noise.

Is it noisy where you live ? Listen to sounds.
What can people do to have less noise ?

Buzz! Buzz! Buzz! Hear the bees.
How many outdoor sounds do you know?
Birds sing. Water splashes. Leaves move.
Sounds of things that vibrate go through the air.
Listen to the outdoor sounds around you.
What outdoor sounds do you like to hear?

Sounds Help Us

Sounds tell us that something is near.
Sounds tell us that something is far away.
They help us in many ways.

How do sounds help you ?

What Sounds Do You Hear?

1. What can you feel that vibrates?

2. What sounds can you hear in these places?

In a city	In a park
On a farm	In the woods

3. What sounds can you hear around you?

In your school	In a barn
In your home	On a train

4. Take a walk out of doors.
   What sounds do you hear?
   What sounds do you like to hear?
   What sounds do you not like to hear?

Sounds I Like to Hear	Sounds I Do Not Like to Hear
Leaves moving Birds singing	

Spring

Spring Is Here

It is spring now where Mary lives.
Winter is over, and spring is here.

Days are getting longer. There is more light.
Days are getting warm. Plants will grow.
Now there are young animals.
The children are outdoors again.
Now they look for changes in the spring.
They go to a meadow and a pond.
They look about for the birds.

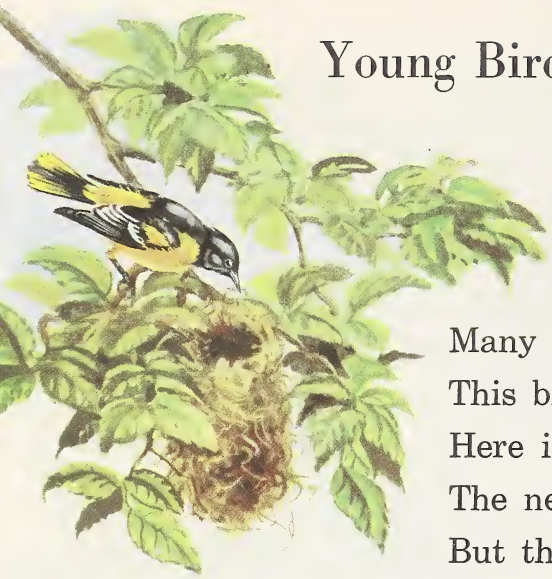
Birds Are Moving About

It is the birds' moving time again.
Last autumn they moved south.
Now they are moving north.

Some birds will stay here all summer.
But some of the birds will not stay long.
They will stop only to eat and rest.
They will stop to eat and rest many times.
Then the birds will fly on and on.
Some will fly far away. They will fly north.
There they will stay for the summer.

The birds were not noisy last autumn.
Now they are noisy as they fly about.
They are not like the birds of last autumn.
In the spring there are many singing sounds.
The birds sing as they build their nests.
Now there are many sounds all about.

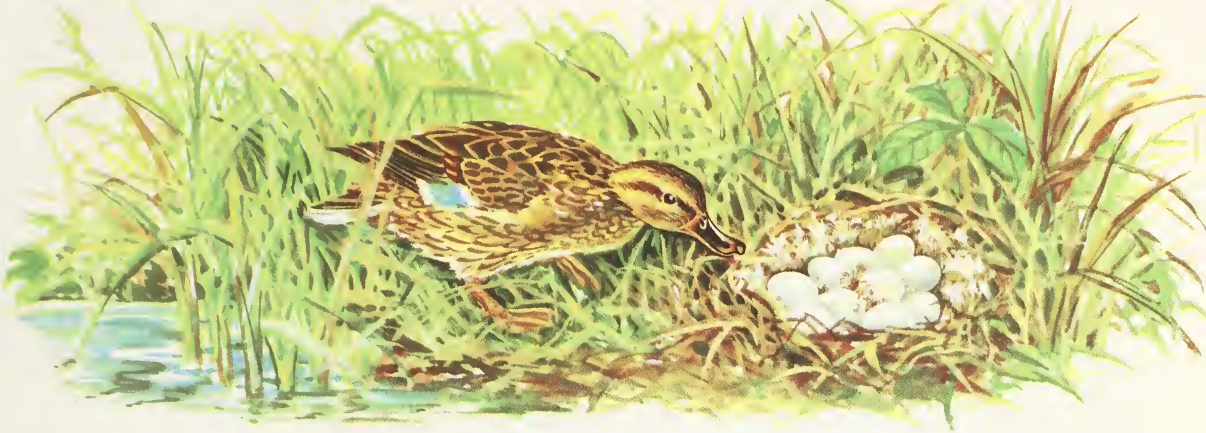
Young Birds in the Spring



Many birds are building nests now.
This bird builds a nest high in a tree.
Here it will lay its eggs.
The nest may swing back and forth.
But the eggs will be safe here.
The young birds will be safe, too.

Tap, tap, tap goes this bird.
The bird taps louder and louder.
It makes a hole in the tree.
The hole gets larger and larger.
The hole makes a safe nest.
The bird will lay eggs in its nest.

Some birds build nests near the ground.
Others make their nests on the ground.
The birds lay eggs in their nests.

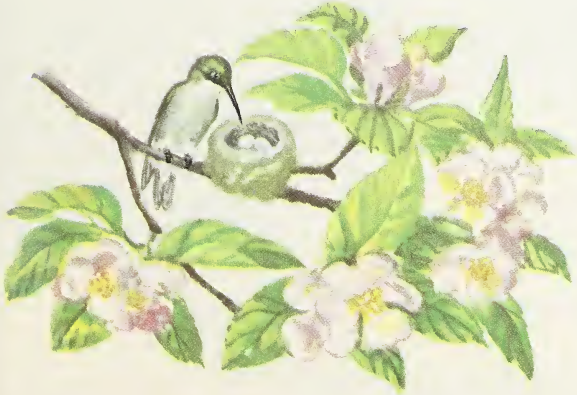


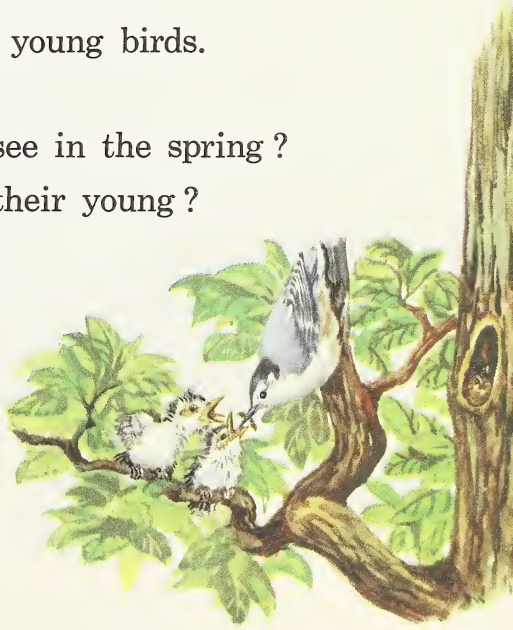
Some birds build nests near the water.
They get their food from the water.

There are many kinds of nests.
Each nest is a good one.
It is good for the bird that uses it.

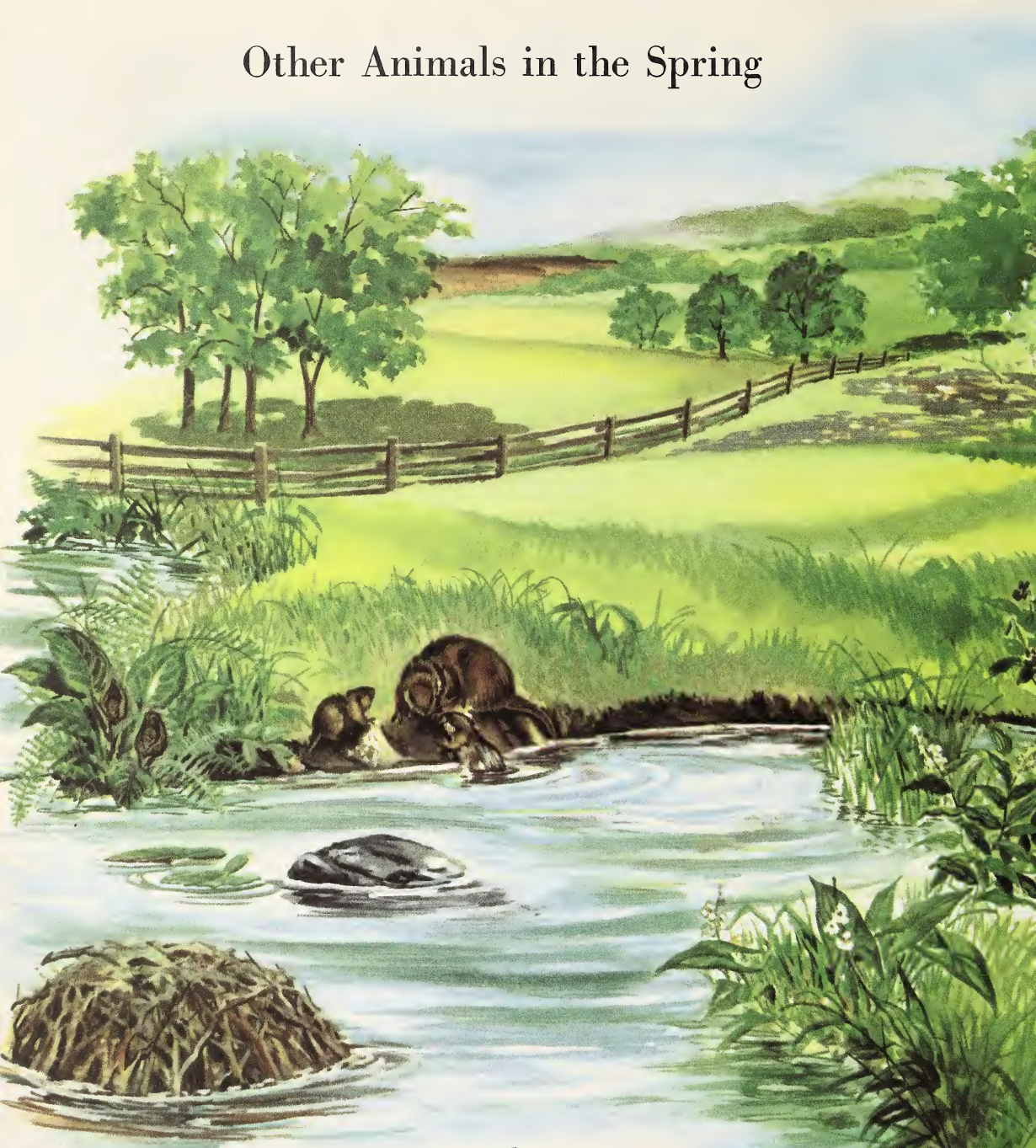
Some nests have eggs in them now.
Some nests have young birds in them.
The birds feed their young.
They feed and care for the young birds.

What young birds do you see in the spring?
Do you see the birds feed their young?

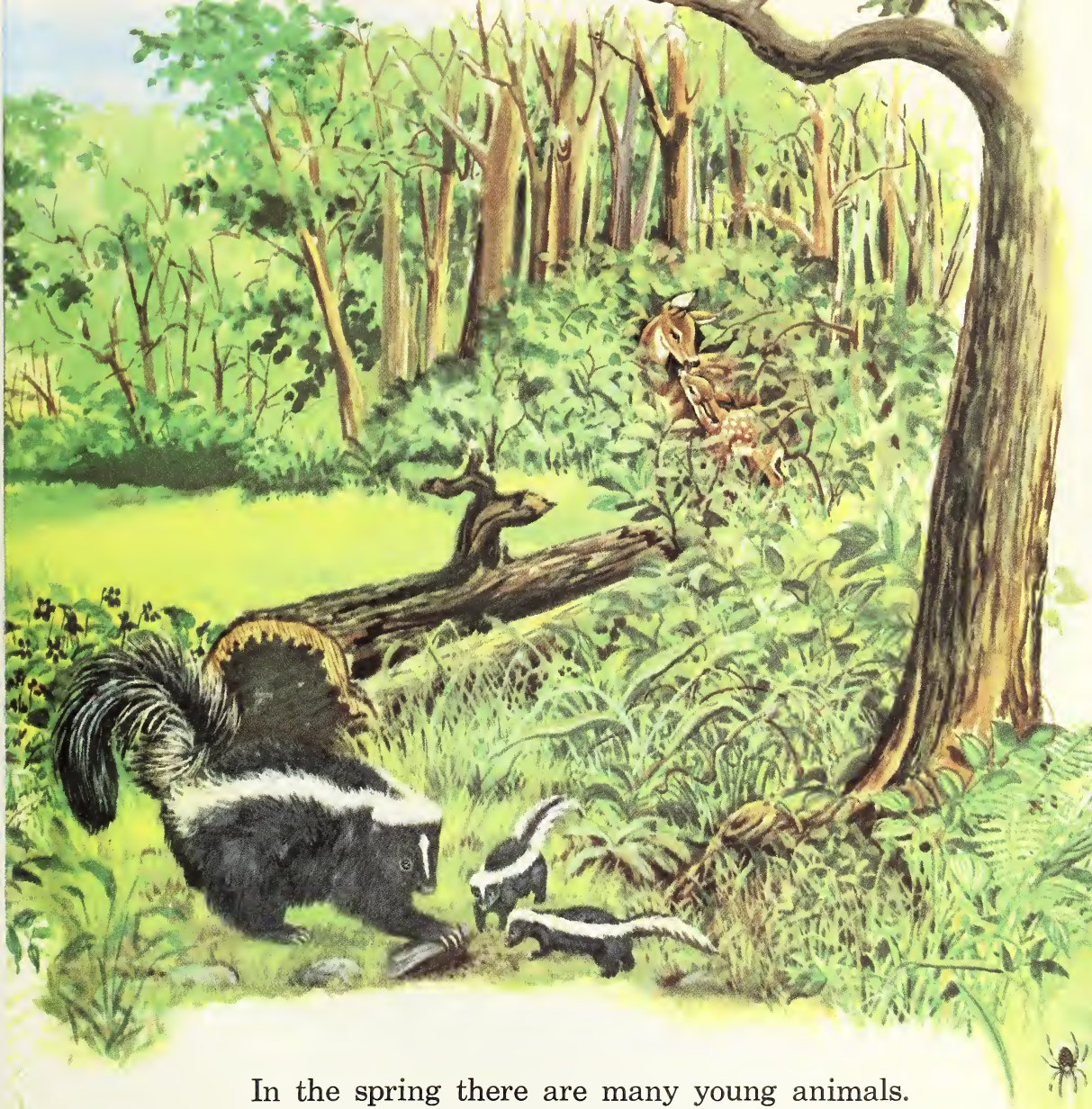




Other Animals in the Spring



These animals are about now.
They go about looking for food.
What animal homes do you see here ?



In the spring there are many young animals.
Some have little care. Some have much care.
Each animal has as much care as it needs.

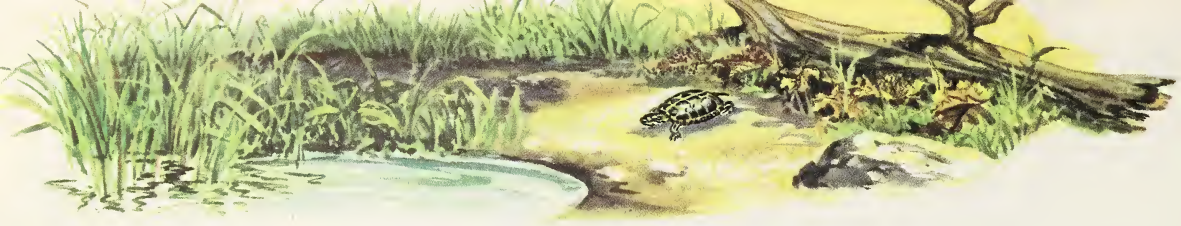
What animals do you see in the spring ?
How do they care for their young ?

Changes Around the School

It is spring at the school.
The children see changes in the spring.
They see new plants around the school.

The children help to care for the school.
They work in many places around it.
They help to make it safe too.
Soon the school will look better.

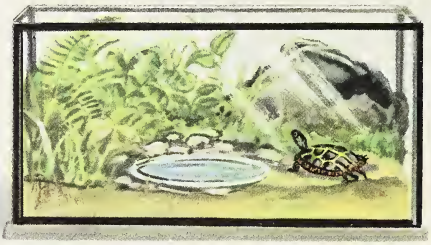
How can you help to make your school look better?
How can you help to make it a safe place?
How do you help to care for the out of doors?
What changes do you see around you in the spring?



Where Should Animals Live?

Mary found a turtle near the pond.
She took the turtle to school.

"Where should we keep our turtle?"
asked Bob. "Is a jar a good place for it?"
"Where did you find the turtle, Mary?"
asked Miss Day.
"I found it near our pond," said Mary.
"We can make a jar like the pond,"
said Bob. "We can make it like the pond
near the woods."



Mary and Bob found a jar for the turtle.
They made it like the pond.
"Now our jar is like the woods," said Bob.
"But our jar is too small," said Mary.
"Our turtle needs a place like the big woods.
Let's take the turtle outdoors."

"Keep the turtle a day or two," said Miss Day.
"Then take it outdoors to live."
"Outdoors is a good place," said Mary.
"A good place for the turtle is the big woods."
"It can be our turtle," said Bob.
"But it will be in the big woods."

Most animals live in places that are good for them. If you bring them to school, they need a good place to live. They need a place much like the one they had outdoors.

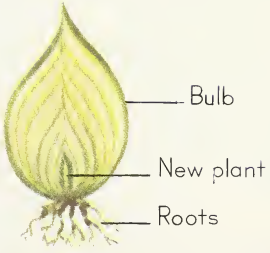
Changes in the Spring

It is spring in the city too.
There are many changes in the spring.
New leaves come out of leaf buds.
The tiny leaves look like red and yellow fluff.
There are many colors in the spring.

What changes in the spring do you see?
Are the days getting longer now?
Watch for flower buds. Watch for leaf buds.
Watch for new leaves in the spring.

Grass is turning green. It is growing.
Grass roots lived all through the winter.
Growing things are making changes.
Spring is here. Days are longer.

Now there are plants with flowers too.
Some plants grow from bulbs in the ground.
The bulbs were in the ground all the winter.
They were alive all through the winter.
New plants grow from the bulbs in the spring.
New plants grow from old ones.



Can you see the new plant in a bulb?

Spring in the City Park

Do you live in the city?
Do you go to the park in the spring?
What young animals do you see there?
What are they doing?

Last winter there were many sparrows in the park.
But now there are sparrows and other birds too.
Some of the birds are moving north.
Some of them stop to rest and eat here.
There is water for them in the park.
Tomorrow they will fly on and on.

But some of the birds will stay in the park.
Some of the sparrows will stay in the park.
Here they will lay their eggs.
Soon they will care for their young.

People in the city want the birds.
They want the birds to stay in the park.
They want the birds to rest and eat there.

What birds do you see in your park?
What can you do to help them?

Spring Comes to a Dry Place

Tom is helping his father.
They are getting the garden ready.
They will let the water go into ditches.
The water will wet the soil.

Soon the soil will be ready for the seeds.
Soon the garden will be green.
The farm will be green, too.

Tom likes the springtime.
He likes to see the water in the ditches.
The water comes from the snow.
It comes from the snow in the hills.
It comes from the hills far away.

It is very dry most of the time where Tom lives.
Sometimes it rains in the spring.
It has rained a little this spring.
Now there are many flowers where Tom lives.

Spring in Many Places

There are a few of these flowers in the spring.
Mary will not take any of these flowers.
There will be seeds. They will make new plants.

There are many of these flowers in the spring.
Mary can take a few of them to school.
She will leave many flowers to grow.

Tom likes this place in the spring.
Many flowers come after the spring rains.

This is Sandy's place in the spring.
It is warm much of the time.

What changes do you see where you live?

Friction

Smooth and Rough Things

Move your finger over sandpaper.
Move your finger over many things.
Which are rough? Which are smooth?

Some things are very rough.
Some things are very smooth.

Rubbing Warms Things

Mary saws the wood.
Back and forth she moves the saw.
The saw rubs the wood.
Back and forth goes the saw.
The wood is very rough.
The saw rubs the wood hard.
The saw is getting warm.
It gets warm rubbing the wood.
Rubbing makes the saw warm.

It is a very cold day.
Bob shows Mary how to warm her fingers.
Mary rubs her fingers together.

Bob rubs the table with paper.
Soon the paper gets warm.
Bob's fingers get warm, too.

Try rubbing a stick with sandpaper.
Does the stick get warm?

Moving a Heavy Box

Bob is pulling the heavy box.
Mary is pushing the heavy box.
They try to move the box over the floor.
How hard they push and pull!
They move the heavy box a little.
Is something holding it?

Friction is holding the heavy box.
There is friction when two things rub.
The box rubs on the floor.

Mary puts a roller under the box.
The roller turns over and over.
Now there is less friction.
The heavy box moves a little.

Now the heavy box moves a little more.
The rollers roll over the floor.
The box moves over the rollers.
Now the heavy box does not rub the floor.
There is less friction with the rollers.

Brakes Stop Things

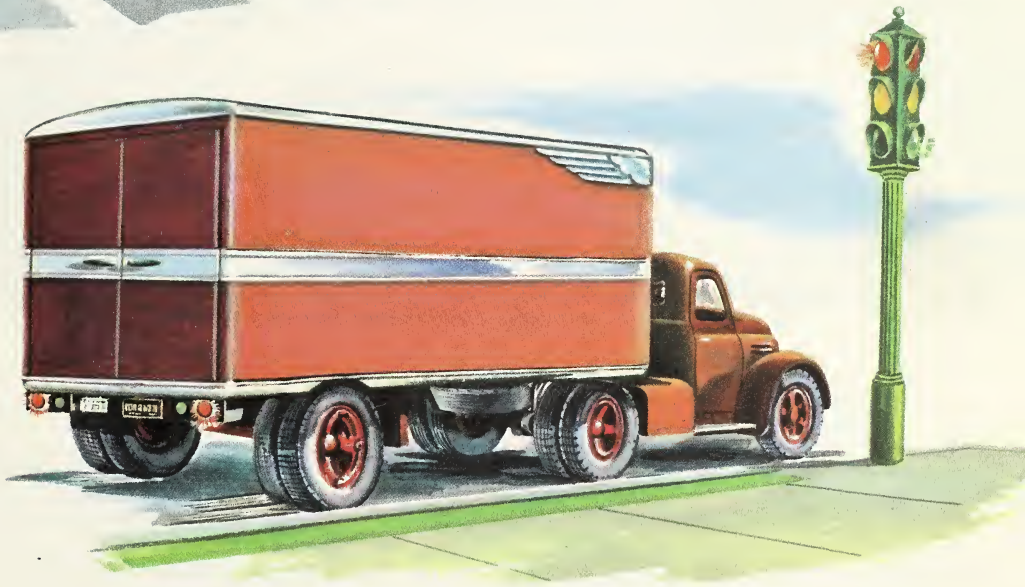
The boy has a stick.
The stick is a brake.
The brake rubs a wheel.
The brake stops the wheel.
Then the wagon stops.

The car has brakes, too.
The brakes rub the wheels.
The brakes stop the wheels.
The wheels rub the ground.
Then the car stops.

Friction Around You

Where is there much friction?
Where is there little friction?

Making Things Stop



What makes these things stop ?

Making Things Move

Making Toys Move

Do you play with toys like any of these?
Do you know what makes them move?
Can you experiment to find out?

You Move Some Things

Bill pushes this train.
It moves when Bill pushes it.
The train stops when Bill stops.

Bill pulls this wagon.
It moves when Bill pulls it.
The wagon stops when Bill stops.

You make many things move.
Then you do work.
Making things move is work.
What things can you move?

Springs Move Some Things

What makes this train move?
Does something in the train make it move?

The spring in the train moves.
Now the train moves, too.
The spring makes the train move.
The spring does work.
Soon the spring will stop.
Then the train will stop, too.

Getting a spring ready to work

What Makes the Train Move?

What makes this train move?
Does Bill push or pull it on the tracks?
Does a spring make it move on the tracks?
What does the work?
How does Bill stop the train?

Electricity moves the train.
Electricity does the work.

How does electricity work for you?

The Wind Moves Things

Sometimes air moves slowly.
Sometimes air moves very fast.
It moves fast when the wind blows hard.
The wind pushes Bill as he walks.
The wind is strong.

Betty has put sails on her boat.
The wind moves the sailboat.
The sailboat moves fast.
The wind moves many things.

The Wind at Work

Some farmers put wind to work.
The farmers use windmills to make wind work.
The wind turns the wheel round and round.
The windmill pumps water for the farm animals.
The windmill pumps water for the people.
It pumps water for the garden.

What do you see the wind moving ?

Water Moves Things

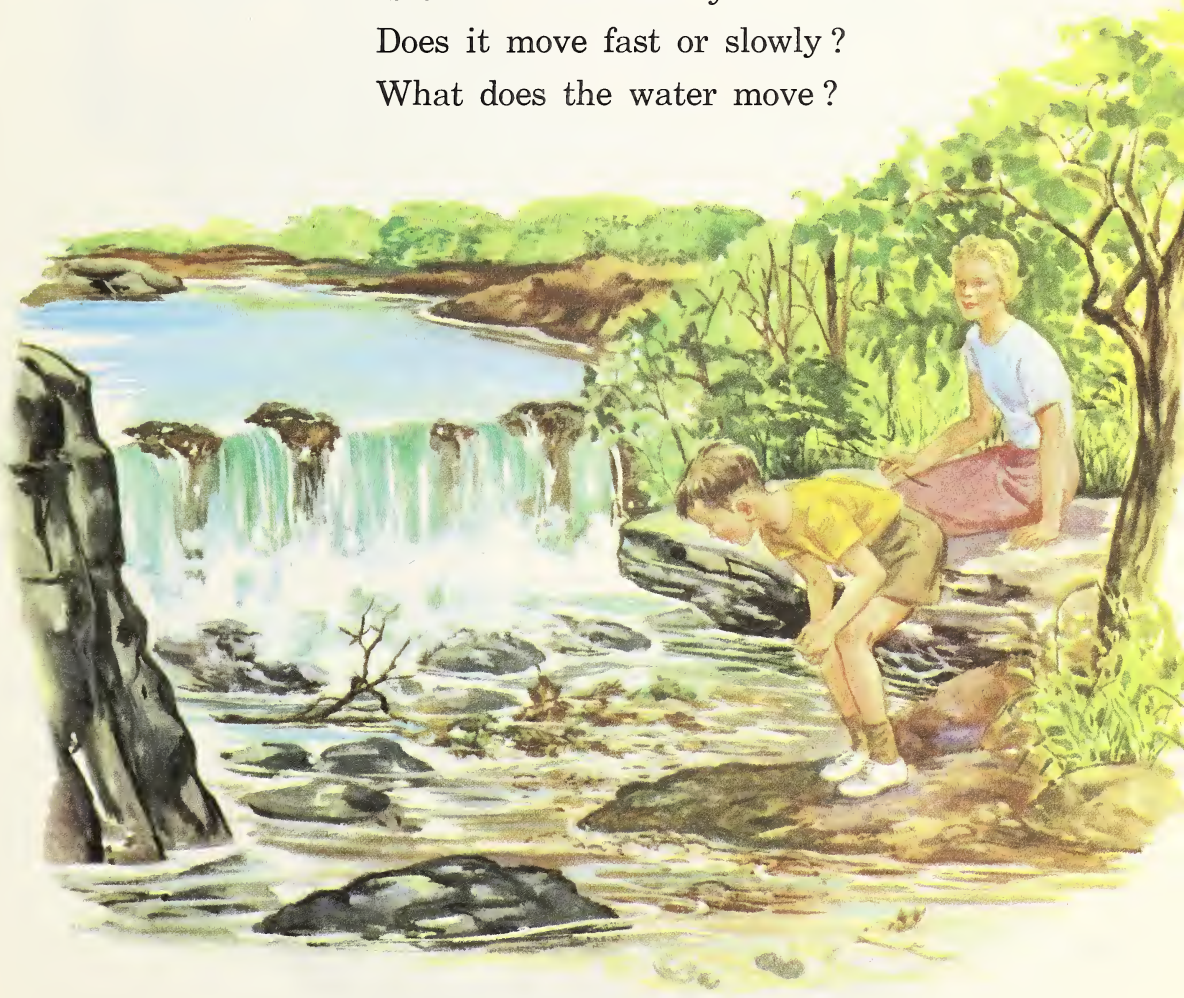
Betty and Bill are playing at the brook.
They are playing with their boats.
The water is moving their boats.
Betty's boat is moving fast.
Bill's boat is moving slowly.

Sometimes water moves fast.
Sometimes water moves very slowly.
When the water moves fast, the boats move fast.

Here the water moves fast.
It falls over the rocks.
It moves the rocks around.
It moves the sand around.

Water moves many things.
Water is strong.

Is there water near you?
Does it move fast or slowly?
What does the water move?

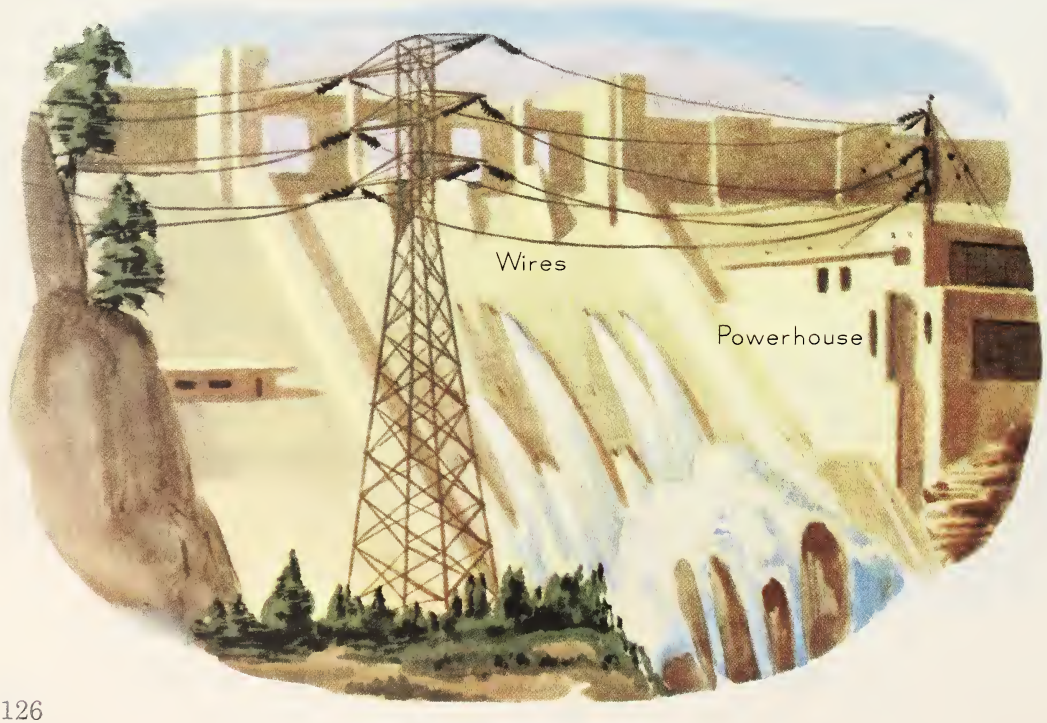


Water at Work

Here is a powerhouse.
In the powerhouse there are big wheels.
Water turns the big wheels around.
The water makes them go round and round.
The wheels turn machines that make electricity.

Electricity goes from this powerhouse.
Electricity goes through wires.
It goes through wires to many places.

Where do you see wires?
Is there a powerhouse near you?



Electricity Moves Things

There is a big train. How fast it goes!
It goes much faster than you can run.
The big wheels help it to move fast.
The big wheels move on tracks.
The smooth tracks help the train to move fast.

Electricity makes this train move.
It comes to the train through the wires.
It comes through the wires from far away.
It comes through the wires from a powerhouse.

Steam Moves Some Trains

The big steam engine pulls the cars.
The steam engine pulls many cars.
It pulls cars from farms to cities.
Steam engines pull many kinds of cars.
They pull them over the smooth tracks.

Water is heated in the engine.
Water boils in the big engine.
It boils fast. It boils hard.
Water boiling turns to steam.
Steam is strong. It moves the train.
Steam can do work for us.

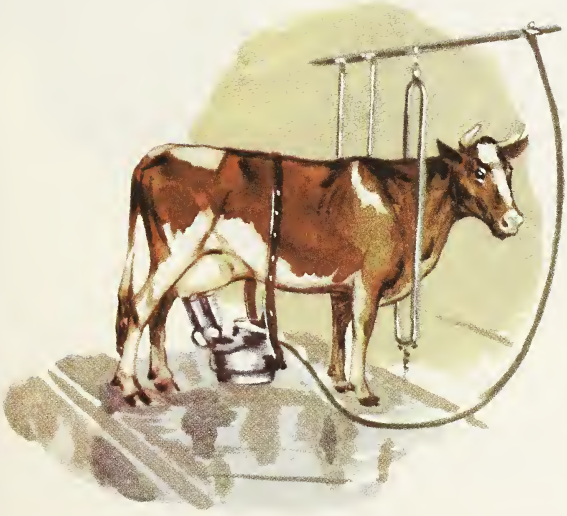
Gasoline Moves Things

Gasoline makes the airplane move.
Gasoline makes the tractor move.
It makes your father's car go.
It moves many machines.
Gasoline does work. It works for us.

What machines do you see?
Which machines use gasoline?

What Makes These Things Move?

What Makes These Machines Do Work?



Care of the Farm

Soil Needs Care

Jim and his father are out for a walk.
They are looking at the farm.

"We have good soil," said Father. "Feel it.
My father took good care of the soil.
He was a good farmer.
I try to be a good farmer, too."
"I will be a good farmer some day," said Jim.

"Farmers must care for the soil," said Father.
"Good soil makes a good farm.
Our soil has not washed away.
The plants on our farm help us.
Our plants help to hold the soil."

Horses Need Care

Strong horses help on the farm.
Strong horses help to do the work.
The horses must have food and water.

Horses must not work all the time.
They need to rest sometimes.
They need a good place in cold weather.
Horses must have good care.
Horses must be strong.

Tractors Need Care

The tractor helps to do work on the farm.
It is a machine. It is not alive.
But a machine needs care, too.
The tractor should not stay out in the rain.
Parts of the tractor are made of iron.
Iron will rust when it is wet.
The tractor will rust when it is wet.
You can find out more about rust.

Put some iron nails in a glass of water.
In a day or two look at the nails.
Do you see rust on them?
The rust is brown.
The nails are rusting.

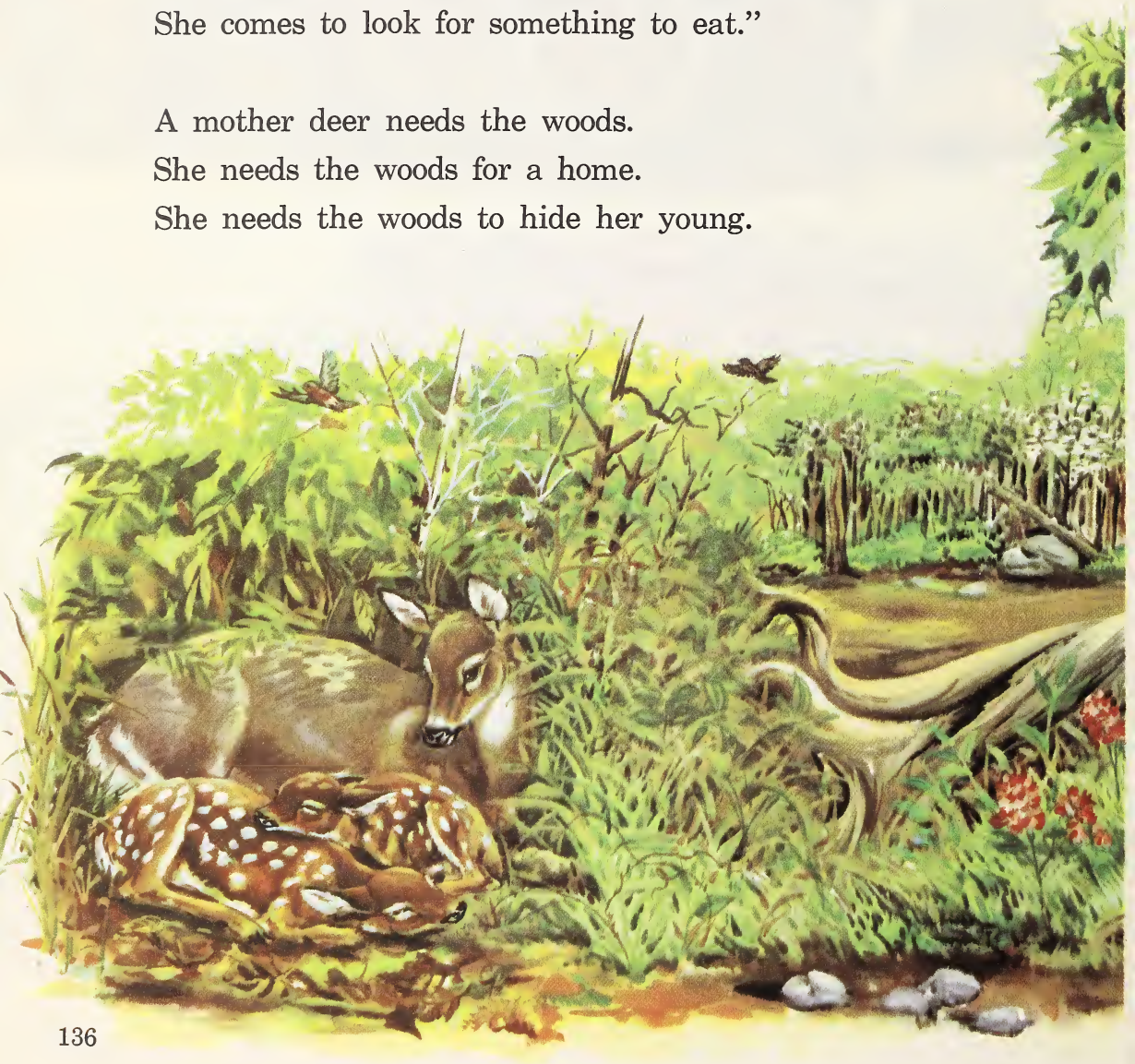
Iron rust on nails

How can you keep things from rusting?

A Home for Animals

"There are many animals here," said Father.
"Our woods are the home of animals."
"Maybe we can see a deer," said Jim.
"Maybe we can see a mother deer," said Father.
"Sometimes a mother deer comes out of the woods.
She comes to look for something to eat."

A mother deer needs the woods.
She needs the woods for a home.
She needs the woods to hide her young.



The woods are the home of many animals.
There are many birds in the woods.
Many of them need trees for their nests.
They need the woods for their young too.
The woods are a good home for some animals.

The Woods Help

"I like to walk in our woods," said Jim.
"I like our woods, too," said Father.
"The woods help our farm."
"How can they help our farm?" asked Jim.

"Our woods are here on the hill," said Father.
"The trees help to hold the soil.
They help to keep the soil on the hill.
The soil does not wash into the brook.
The brook does not take the soil to the river."

The Leaves Help

"Look how the leaves cover the ground," said Jim.
"The leaves make a carpet."
"They make a very good carpet," said Father.
"The carpet helps to hold the soil, too.
The trees and the carpet of leaves help.
They help to hold the soil on the hill.
They keep the soil from washing away."

"The leaves on top look dry," said Jim.
"But the leaves under them feel wet.
The ground feels wet, too."
"The ground does not dry quickly," said Father.
"The leaves help to hold the water.
The leaves help to hold our soil.
Our soil does not wash away."

Here there are many leaves on the ground.
The leaves fall year after year.
The leaves dry and break up.
But they help little plants in the winter.
They cover the plants in the winter.
The leaves help to keep the ground wet.
They keep the little plants from drying out.
They help the plants to live during the winter.

The roots of the plants live under the snow.
They live all through the winter.
Then the plants grow and grow in the spring.

Young Trees Grow

Jim and his father look at the young trees.
Many little pines and other trees are growing.

These trees are part of the farm.
Trees grow here all the time.
Sometimes a few trees are cut down.
But little trees are planted.
They are planted where big trees were cut.
Little trees are growing all the time.

Jim's father plants young trees.
He takes care of his forest.

Soil Helps the Farm

"This soil helps to make our farm," said Jim.
Father said, "It helps all our plants to grow.
We could not have a good farm without good soil.
We need good soil. We need good forests.
Our country needs good soil and good forests."

Watching Plants and Soil

Take a walk in the woods near you.
Do you see a carpet of leaves?
How do the leaves help?
Do you see young trees growing?
How are the woods cared for?

Take a walk near your school.
Look at the soil around you.
Does water wash the soil away?
How can you help to care for the soil?

Plants will not grow well without good soil.
Our country needs good farm lands.
Our country needs good forests too.

Experimenting with Soil and Water

Find a place where grass is growing.
Pour water over it. What happens?
Where does the water go?
Is any soil moved away in the water?

Find soil where no grass is growing.
Do you see dust in the air?
Does the wind blow dust around?
Pour water over the soil where there is no grass.
What happens? How does the water look?
Is any soil moved away in the water?

Cover the soil with leaves.
The leaves make a carpet.
Pour water over the carpet of leaves.
What happens? What do you see?
Is much soil moved away in the water?

Did you find out these things about soil and water?
Grass and leaves help to hold the soil.
Then the soil is not moved away by water.

We need good soil. You can help.

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TEACHERS' MANUAL

for Science Around You

SCIENCE TODAY AND TOMORROW

Gerald S. Craig
Etheleen Daniel

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Foreword

Science Today and Tomorrow

During the last twenty-five years, science has grown steadily in the elementary schools of the United States, Canada, and various countries of Europe, Asia, and Africa. This is no ordinary event, for new areas are not easily established in the elementary school, owing to the tremendous pressure of various groups to gain the attention of children.

Science in the elementary school has to a large extent been developed by classroom teachers. They have experimented with new activities, new content, and new methods. Many of them have constructed curriculum materials and developed reading materials in science for the elementary school. As a result of this work, instruction in science in the elementary school is uniquely designed for use by classroom teachers.

The new elementary-school program with its emphasis on science is a feasible program because it recognizes that the classroom teacher has many professional tasks; teaching science is but one of them. The teacher is a specialist in the education of children and not necessarily a specialist in science. There is no need for classroom teachers to feel any responsibility for specialized science tasks, such as naming all the objects in the environment, animate or inanimate, or serving as a field naturalist, a laboratory technician, or a general bureau of information.

It is evident that only those subjects that are in keeping with the basic purposes of the elementary school succeed in maintaining a permanent place in its curriculum. The American elementary school is a unique institution. It has been called at times "the great common school," in that it is the school for all the people. It was established by the early forefathers as the one institution that would be common to everyone, regardless of race, religion, economic status, and future occupation. It has become the basic institution dedicated to the task of the education of all people for citizenship in a democracy. A significant part of the success that science has had can be accounted for by the fact that elementary-school workers have been concerned that science be developed in the interests of *all* boys and girls. This pattern for science in public elementary education is being adopted by a number of democratic countries.

Science from the Developmental Point of View

Science in the education of children should be considered wholly from a developmental point of view. Recognition will then be given to the fact that children do not come to school for the first time at zero in science learning.

They have had a wide range of rich experience with physical and

biological phenomena. They may have had a variety of experiences including those with friction, momentum, inertia, magnetism, static electricity, simple electric circuits, snow, ice, water, steam, melting, boiling, freezing, conditions necessary to certain living things, care of animals, seasonal change, the sun, the moon, stars, clouds, mirrors, magnifying glasses, evaporation, condensation, varieties of kinds of locomotion found in the animal world, animal mouths, ears, noses, coverings, balance with building blocks, wagons and tricycles, heat and cold, effects of seasonal change, different animal habitats in the community, solution of solids in liquids, molds, the large number of seeds produced by some plants, and so on. They may bring with them misconceptions and superstitions, or they may come to school with a good attitude, conducive to learning and the development of intelligent and resourceful behavior.

Many teachers of children find it useful to accept a point of view of dynamic psychology for understanding children. Their ideas may be stated simply in such words as these: A child lives in a dynamic universe which is new to him. He is challenged by his many experiences. This universe is filled with a great variety of objects. He is impressed by the events (phenomena) small and large occurring about him, such as rusting, rain, weathering rocks, electrical shocks, thunder, wind, and falling objects. He finds himself in normal circumstances tremendously stimulated and turns naturally to exploring and learning.

A young child is naturally egocentric. He is not to be condemned for being so; his egocentricity grows out of his great potentialities for ceaseless drive and for adjustment and understanding of his environment and himself. As a result of the great drives and yearnings, he feels inside himself a whole gamut of emotions which are to him discoveries about himself. He may display grief, irritability, anger, restlessness, impatience, and disappointment. Although such expressions are not to be condoned or encouraged in children, they are not to be considered in themselves evil, for out of these emotional drives have come many of the great constructive developments of mankind, such as democracy, better living conditions, religious freedom, and improved health.

A child is an energy system, and in all the universe we do not find its equal. It is remarkable that out of the use of his energy, a child is becoming intelligent in a universe filled with a vast variety of living and nonliving objects, an almost kaleidoscopic array of events and changes. Within his rapidly widening universe, the child attempts to identify himself and his inheritance. Viewing children from this dynamic point of view assists parents and teachers to understand that the drives of children, which are so frequently annoying to the adult, are potentially constructive traits.

A child learns about his environment whether he is taught science or not, although some of his learning may be negative in value. The kind of science learning considered in this Manual begins in the cradle. As a child begins to separate himself from his environment he begins to develop learnings based on these experiences. Parents and teacher must recognize that there may be learning about the environment even though a child is unable to state meanings in words. For instance, a child is experiencing something with the rattle he places in his mouth although he has no words with which to shape thought. He is learning something about the earth and its gravity as he pushes his weight against it in taking his first steps. Were the earth like a suspended rubber balloon that bounced away from him, or if the gravity were not constant and pulled him with greater force at some times than at others, he would develop a different set of attitudes and behavior. In considering science in the program of elementary education, it is well to conceive of science experiences as beginning with birth. In a real sense, the adjustment to the environment can be traced back to the prenatal stages.

In a very real sense, we might say that the potentialities of science are inside human beings. To make it more personal we may think of these potentialities as being in such human beings as ourselves—teachers and children in the classroom. This is true because science has grown out of a tremendous urge on the part of mankind through the long centuries to come to an understanding of the universe.

Man, from the remote past, has sought explanations for the things that happen in the world about him. The rainbow, birth, death, life, lightning, and other events challenged him. He frequently used great ingenuity and much fancy to develop explanations for the phenomena about him. The myths and legends of many peoples indicate men have felt that if they could understand the world about them they might know more about themselves, their origins and history. The fact that primitive people frequently associated their explanations with their religious beliefs demonstrates how important such explanations were to them. In fact, these explanations had much to do with man's adjustment to the environment. Sometimes man's explanations made him fearful and superstitious; at other times they filled him with confidence, calm, and resourcefulness.

According to the developmental point of view, the origin of science is in man's distant past. An implication of this for teachers in the elementary school is that science need not be thought of as something foreign to them or to the children they teach. Science as we know it today, with its discoveries and inventions, is the result of urges in men and women through the ages. We can see these same urges in children as

they follow their natural drives and as they attempt to secure adjustment and equilibrium in a dynamic universe. They use the senses of smelling, tasting, feeling, seeing, and hearing, the kinesthetic sense, imagination, curiosity, energy, irritability, restlessness, play response to external conditions, and other partly understood drives deep within their natures to project themselves into the areas of the environment. They depend upon impulse, fancy, creative activities, and logical thinking just as their ancestors did.

From the developmental point of view not all of science is difficult. On the contrary, from this point of view science is part of the earliest learnings of children. Furthermore, the technical, vocational, and specialized aspects of science have no function in elementary education. Elementary science is closely related to the experiences of children and to the kind of thinking they can do, so that teachers need have no fear of science. The teacher can learn the science that is needed while teaching science at any level in the elementary school.

The fear of science felt by some adults is not usually found in children. The adult may have been conditioned to a dislike of science in part by previous contacts with science instruction at high school and college levels, whereas children, having felt no such conditioning, are still following their natural impulses. Teachers can free themselves from their negative reactions if they will attempt to see the environment and science through the eyes of children. Encouraging children in a classroom to express themselves freely about their ideas of natural events has assisted many teachers to understand children and at the same time to gain a new look at the world for themselves.

Using Science in a Democracy

There has grown up a conviction that the free nations must remain strong if they are to remain free. There is also a realization that there is power in science, and therefore that science is an essential element in maintaining and improving the democratic way of life. It will not be enough to have a small portion of the population educated as scientists; to be truly strong, an entire nation must be conversant with science. To realize this goal, science must be placed in the curriculum as one of the fundamentals. Making a whole nation conversant with science is a task uniquely suited to the elementary school, since this is the institution of all the people. It is the institution which has in its enrollment not only the future scientists but laymen as well (everyone is a layman outside his special field).

Strength for free peoples is secured through the development of good

living conditions as well as military defense. Through the use of science man can do much to shape his own future, since science has tremendous potentialities for the improvement of living conditions for all.

The children now in the elementary schools will live in a world of tomorrow. Our boys and girls will live in a time of great decisions. They will need to make certain that science will be used for good and not for evil. They will need to determine how democracies can be kept secure. There will be great problems concerning the use of new and old sources of energy. Theirs will be the problems of wise utilization of natural resources, the distribution of new synthetics, medicines, and drugs, provision for health and well-being, development of materials from new sources, establishment and maintenance of research agencies dedicated to public welfare, the establishment of a balance of nature that will provide ample food and recreation for all, and the creation of a stable economy based on the natural resources and other problems to be solved, all within a democratic framework. Through all of this there will probably be a consideration of problems of international and world co-operation.

As we seek to determine what shall be the basis for our instruction in science in the education of children we find we must look to something more permanent than a mere teaching about objects. We make this decision because in a few decades we ourselves have witnessed a vast array of new inventions displace objects which once seemed permanent. Kerosene lamps have given way to electric lights in many places. We have observed the transition from telegraph to television. Our familiar world is in constant transition. So, although we may utilize objects in teaching children, we cannot base our curriculum on objects. We must look deeper for our basic purposes.

Some might say that our major purpose is giving children content. But the content of science, important as it is in the education of children, does not constitute the fundamental purpose of including science in the elementary curriculum. This is true, first, because our basic purpose must be in terms of children and society, and consistent with the dedication of the public elementary schools to the principles of democracy. Second, as we shall see later in this introduction, we must recognize that the content of science is not absolute; what we think is reliable information today may need revision tomorrow.

What we can be certain of is that boys and girls will need to be resourceful and democratic in the decades ahead if their and our way of life is to survive. Therefore, we are concerned with the development of resourceful and democratic behavior. If we succeed, we shall not need to be unduly concerned for the future, for with the development of

resourceful behavior in accordance with the high purposes of democracy, our boys and girls can use science to shape the future with complete confidence.

It is to be noted in this discussion that science is considered as a tool for humanity. There is no intent in the education of children to develop science for its own sake or to defend science as a vested interest. Only as science serves in the development of children and in the welfare of humanity can it be defended as essential in the education of elementary-school children.

It is most important that we recognize that boys and girls need to do much more than talk about science. If democracies are to preserve their way of life, there must be in their populations the ability to operate intelligently and resourcefully with the materials and energy of the universe to the best interest of mankind.

Social studies, however valuable they may be, are not sufficient in themselves to help children meet and solve the problems of today and tomorrow. Teachers and school systems are likely to miss the great contributions of science to children and through the children to the larger goals of democracy when they place science in the curriculum as a segment of the social studies. Science grows out of the tremendous urges of the human organism and does not have to be motivated through social studies. Many students of children think that science by its very nature is more challenging to young children than social studies. This is not to be interpreted as an argument against the social studies. It is, however, an appeal that curriculum workers thoroughly think through the concept that science is a part of the development of children. If properly guided, children can grow in intelligent and resourceful behavior just as they can grow physically if properly nourished.

Some have suggested that the primary purpose of science in the education of children is to develop "little scientists." Such an idea is not consistent with the fundamental purpose of the elementary school and the origin and nature of science in society. There should be no hero worship of scientists except in so far as an individual scientist deserves it. Democracy will be weakened if a society is created with a distinct scientific class. Scientists serve, but so do soldiers, senators, artists, carpenters, barbers, farmers, doctors, and everyone else. Scientists now and then outside their own special fields are somewhat naive, and at times exhibit traits of gullibility and dogmatism, thus violating the fundamentals of science. Scientists are human beings like other people. We should not set up the lives of scientists as ideals for children to follow, regardless of how much we may appreciate the contributions of science.

The Nature of Modern Science

In science we do not view knowledge as absolute. Any statement of science can be challenged, revised, or refuted with suitable data. There is no room for dogmatic attitudes. There can be no dictator for science.

Through science, man strives always for a better understanding of the world. Unfounded prejudices, opinions, gossip, rumor, astrology, myths, intuition, and superstition cannot be considered reliable sources.

Science is an active, dynamic field, constantly demanding willingness to make new observations, to repeat experiments, to consider new facts, and to challenge earlier conclusions. Science is far from a finished subject; in fact, it is likely that it is only in its beginnings. All the areas of science are undergoing changes as a result of continuous study. New ideas are being added and old ideas revised about stars, ventilation, living things, diseases, nutrition, and other areas of science.

Man learns through experiences by means of his senses. Science has produced new instruments, such as telescopes, microscopes, and others, that extend man's range of observation and experience. Nevertheless, to explain many happenings in nature, even everyday occurrences, is exceedingly difficult in spite of many new technical tools. So scientists have been forced to develop provisional explanations, or hypotheses, to guide them in further study of some things. But scientists must abandon any hypothesis as soon as it is found to be unsatisfactory. There is much that scientists have not satisfactorily explained. Many times a scientist must say he does not know even about problems within his own field of specialization, and even though he may by all rights be the world's leading authority on the problem involved.

Since man is continuously in the process of making new discoveries and revising his information, accuracy is not an exact status. This means that we do not teach a fact as though it must be true for all time. It indicates, also, that we cannot teach all the truth to a child about any single subject. We may, however, attempt to make certain in the classroom that the way in which a child learns is consistent with scientific attitudes.

We cannot hastily call an item correct or incorrect. Instead it is essential that in all our discussion, reading, experiments, and so on we determine what is the most reliable information at a given time. It may not be as serious a matter to be mistaken in the information we may have at any time, as to assume that there may be no need to secure new information on all important matters throughout our lives. It is also a serious matter to pass along information as if there were no question about its accuracy when we are not sure of its reliability. The nature of

modern science is thus entirely consistent with the idea that learning takes place through the continuous growth and development of large concepts. It also indicates how necessary it is to view education as a process which takes place from the cradle to the grave.

Accuracy is a direction toward which man in his best efforts strives. It is also a goal toward which teachers and children can move in teaching and learning; it calls for growth for both teachers and children. A child's ideas gained from science can be accurate in so far as they go, but as a child proceeds through the school his knowledge about any one subject increases in amount and detail. In other words, we may not be able to teach children all the reliable information in science about a given subject, but what we do teach can be consistent with what is reliable. Authoritative books such as those in the SCIENCE TODAY AND TOMORROW series can be most useful to both children and teachers in maintaining a high standard of accuracy and a sound development of attitudes.

Science and Behavior

This condensed description of the nature of science has been provided because it has many implications for the teacher and can provide him with a sense of security and adequacy in teaching children. The teacher has the right according to science to play an honest role in the classroom. He has a right to admit that he is learning; that he makes mistakes sometimes; that sometimes a child with a special interest and concentration may be learning faster than he is. In a real sense, the scientific method is a method of honesty, and neither teacher nor child should be penalized in any way for being honest. The learner should never be humiliated for the admission of ignorance. The implications of science for mental hygiene and human relations are profound.

It would be well for the teacher to consider the implications of science in the development of such behavior patterns as open-mindedness, critical-mindedness, and the avoidance of gullibility. There is no greater educational factor operating in the modern world than the attitudes that teachers and parents utilize while working and living with children.

In science it is important to state the source of one's comment in explaining a phenomenon, such as evaporation of water, hibernation of animals, erosion of soils, and so on. For instance, one might say, "I read an explanation in . . . ," or "It may be . . . ," or "My father said . . . ," or "On my way to school I saw . . . ," or "I think it might have been," or "I used my imagination," or "I think I am right," or "I can do an experiment to show . . ." This is preferable to giving such information as if the statements were unquestioned facts. We have

sometimes called this identifying the source of a comment. The teachers and children should develop the behavior pattern of identifying the source of a comment.

Both teachers and children have a right to use their imaginations, to speculate, to repeat information as long as they distinguish between reliable and unreliable information. Such a behavior pattern is in the direction of assuming responsibility for one's own speech. It is quite different from the behavior of gossip, loose talk, and rumor spreading.

This type of development should not be allowed to harm the good human relationships of children. Frequently children use parents' opinions as reliable information. It would be well for the teacher to handle such comments in a manner that will in no way decrease the child's respect for his parents. In a sense, the attitude of the teacher may be that we are glad to have what the parent has said, and indicate that further development of the statement is given in authoritative books. Perhaps the comment might be, "What do persons who spend their lives studying this kind of thing say?" Science instruction should be utilized to improve the human relationships of children, those of children with children, children with teachers, and children with parents.

It is obvious that the great behavior patterns growing out of science are not built in a finished manner in a day or a year or a decade. For instance, critical-mindedness and open-mindedness require time for development. Development of the patterns associated with resourceful, democratic behavior should be considered a continuous program throughout the elementary school.

There is considerable evidence that three great achievements of mankind—democracy, scientific method, and religious tolerance—developed contemporaneously and out of the same general struggles. An examination of these achievements will indicate that these three have much in common in basic meanings. In the opinion of many students, real science cannot exist outside a democracy.

The Content of Elementary Science

Almost everyone is impressed with the extensive nature of science; it has indeed grown tremendously in scope. No one can learn all of science in an entire lifetime. It is also obvious a teacher cannot teach it all. Only a very small portion of the total science will be taught to children, but that portion can be most important in the development of citizenship. The question of how much content of science is taught is not of nearly so great importance as is the question of what content of

science is taught and how it is taught. With the world situation as it is today, it is most important that the content and procedures of science suggested to teachers and children in such a series as SCIENCE TODAY AND TOMORROW be those designed for the preservation and advancement of democracy.

Because of the extensiveness of science, there has been a tendency to develop what might be called encyclopedic instruction. Under this method students have been required to learn wide areas of content. Comprehensive instruction has been developed about animate and inanimate objects and about topics in the environment, with little sensitivity on the part of curriculum makers as to the value of the content to the teacher and children involved. In the encyclopedic type of instruction the purposes of science in elementary education became lost in small content and busy work.

A traditional trend in nature study has been to make science instruction dependent upon an incident approach. If a child brings in an object, such as a rock, a feather, or a flower, or if he can relate an interesting experience, then there is instruction in this field about the object or incident. If there is no object or no incident, there is no science instruction in such classrooms. Science becomes incidental and accidental in the classrooms of teachers holding to this point of view.

But science is no incident in the lives of children. In fact, it is and probably will continue to be one of the most dominating and decisive factors in their entire lives. Schools developing science on an incidental basis will not provide boys and girls with the education they need for the great decisions they must make for themselves, their country, and the world.

This is not to say that incidents have no place in teaching-learning situations. Natural incidents can be used as experiences for concept-formation and for the development of understanding of phenomena. But science with its profound and challenging ideas has a great contribution to make to the formation of concepts and important ideas. If our democracy is to survive, we must make certain that the potentialities of science in our way of life will be developed. This instruction must not be incidental.

Since the best information scientists have at any one time will need to be revised in keeping with future discoveries, a content of science in the elementary school cannot be considered as set and fixed for even a few years. There are, however, certain patterns for the universe which seem to persist as profound descriptive principles for all time, in spite of revisions and modifications that follow new discoveries. These patterns are described in the following statements:

a. The universe is very large.
b. The earth is very old.
c. Many changes are going on in the universe.
d. Living things are interdependent and interrelated.
e. Living things which are living today are the results of adaptations that have been made in the past.
f. There is a great variety among living things.
g. There is evidence of a tendency toward balance among the forces and living things.

For the sake of brevity, we can speak of these patterns as principles of space, time, change, interrelationships, variety, adaptations, and balance.

These patterns seem to be guide lines for instruction through the elementary school. A child can continue to grow along the lines of these great principles or patterns. The experiences an individual has throughout life can enrich his understanding of these principles. Man must recognize these patterns if he is to adapt his civilization to this universe. A knowledge of these basic patterns is necessary to the understanding of the world's problems and life's experiences in our modern democratic world.

The Large Patterns of the Universe as Guide Lines for Teaching-Learning

The Universe Is Very Large—Space

As man has studied the universe that surrounds the earth he has become impressed by the immensity of space. The earth which he thought was very large and the center of everything is small compared with many other objects in the universe. This earth is one of several bodies which revolve about a star known as the sun. The sun is one of millions of stars which compose a vast galaxy of bodies called the Milky Way. Man has learned that there are many other galaxies within range of the modern telescope.

While a complete understanding of the immensity of space is undoubtedly beyond the mental capacities of any one individual, it can become a guiding factor in the interpretation of the experiences of children at all levels. The young child may begin his growth in the understanding of space as he begins to associate with himself the rooms in his home and the yard or immediate vicinity about his home. Later, he learns the location of the nursery school or kindergarten when he is taken there by adults or by school bus. Still later, he goes to school by himself and learns where the homes of his relatives and friends are in

relation to his own home. As he travels to neighboring communities his world becomes larger. He may be intrigued by the observation that the sun and moon seem to follow him as he moves about.

A child's early contact with this pattern may merely teach him that the earth is a very big place compared with his familiar neighborhood. He may become acquainted with the appearances of the day and night sky. Later, his learning will reveal that the earth is very small in comparison with the stars and space. About the same time he will also learn that the stars are suns which are very, very far away. In later years he increases his understanding of the vastness of space by learning about the extent of the solar systems, the Milky Way Galaxy, radio stars, cosmic rays, the galaxies, the light year, and so on.

Any adult who has read modern astronomy, has attended lectures in this field, visited an observatory or planetarium, or considered the possibilities of space travel knows that his conception of space continues to change after childhood. There are new, challenging thoughts for all levels—the junior high school, senior high school, and college levels—and, for that matter, many new discoveries still to be made by the astronomer. Some comprehension of this conception is essential to an appreciation of the significance of science in its revolutionary effect on modern thought. It is important that children should be started properly along this path rather than allowed to absorb inaccurate and unscientific ideas of the universe and astronomical bodies and to grow up with earth-centered conceptions in an age of modern science.

The Earth Is Very Old—Time

The conception of the great age of the earth and of the universe has come to mankind as a revolutionary idea. Not only has it profoundly influenced scientific understanding, but it has altered man's attitude toward his own place and function in the universe. It was natural for primitive man to think that the earth had been formed just a short time before the advent of his people. Much of this primitive belief came down into modern times and still controls thought in scattered areas. Children in their early years may learn that soil is made from rocks, and through activities, observations, and experiences discover that the process of soil formation took a long time. They may also learn something about the forces which operate upon the earth to produce changes; that it was a long time before the earth became a suitable place for plants and animals; and that many kinds of animals have lived on the earth and have become extinct. These ideas furnish him useful content in constructing his understanding of the great age of the earth.

Children may have a variety of interesting experiences with earth forces: for example, they may examine pavements broken by water freezing in winter; feel rocks softened by the action of weathering; observe erosion after a rainstorm; note how plants keep soil from eroding; examine different kinds of soil with a magnifying glass.

Time is something to be learned. Children must learn the concepts of yesterday, today, and tomorrow; the meaning of a second, a minute, an hour, a week, a month, a season, and a year; the sequence of seasons; the varied lengths of life of living things. A tree may be several hundred years old, and on the other hand, a moth may live only a few weeks.

Time is relative to both children and adults. A half hour may be a long time waiting for a plane or train, but very short if we are playing. A year between birthdays can seem a long time, but it is short in terms of the centuries the Indians have lived in the Western Hemisphere. The teacher and the parent can greatly enlarge children's concepts of time.

In later work children may learn something about what has happened to the earth, the causes of natural features in various localities, the long ages of prehistoric life, the struggle of life for existence, the forces operating on the earth, and some of the changes that have taken place on the surface of the earth. This comprehension of the great age of the earth is essential to an appreciation of the antiquity of man and of man's attempts to build social institutions for his own welfare. The goal is not the memorizing of a chronological sequence of events, but rather an approach to the modern conception of time. These ideas reveal to man the importance of building his social and political structure with the thought that he may live on this planet for some time to come, provided he uses his intelligence to assure survival. These concepts are fundamental to building an understanding of what is intelligent utilization of natural and human resources. This understanding is necessary for man's planning for his own future.

This background to an appreciation of the modern concepts of time and change should tend to inhibit chauvinism; it should teach each pupil that all life existing on the earth today is the result of a long succession of living things—a development involving a vast number of individuals and extending back to the beginning of life on the earth.

The mountains, rivers, valleys, plains, seas, and other physical features that we think of in connection with a given nation and that often come to be revered by the people of that nation have not always been there as they are now. The surface of the earth has changed its appearance many times in the past and is constantly changing today.

As the result of a long series of experiments in the art of living, man has become a dominant force in nature, and we have a right to feel a

pride in the achievement of all mankind. It must be emphasized in our instruction that this achievement is restricted to no one race or nationality.

Changes Occur Continuously in the Universe—Change

The conception of change permeates all fields of knowledge, and man must consider these changes if he is to operate intelligently with natural forces. Modern geology reveals that our physical environment does not remain constant, that the history of the earth is a story of change—change in climate, in topography, and in the succession of living things.

The conception of change is manifest not only in geological history but in living things, as, for example, the changes produced by birth, growth, age, and death. There are also changes produced by the biological principles of struggle for existence; and these cannot be ignored by man in his striving to adapt the world to his needs. Then there are the changes produced by energy and movement. Astronomical bodies are seen to have changed position and character through cycles of time. The scientist learns to look for change in his explanation of phenomena; the layman must expect change as a condition of everyday life; the student of social studies and the citizen must anticipate change in the political, social, and economic structure. Information concerning changes produced by physical and chemical phenomena, developed in terms of children's own experiences, can be introduced during early school years and continued through later levels.

Children see water disappear from a dish by evaporation. They pick up rocks which have weathered so much that the rock disintegrates into small pieces in their hands. They see the changes in the sky, in the weather, and in seasons.

Illustrations of change include such phenomena as rusting of iron, melting of ice, boiling of water, weathering of rocks, variations of weather and of seasons, and innovations produced by man's discoveries and inventions.

School windows should be utilized more fully for the study of the succession of changes due to weather, to the seasons, to the time of day, and man's activities in relation to these changes. Brief excursions around the school ground will provide varied experiences depending on the region. The children may see frozen, muddy, and dry soil; the growth of plants; and a variety of plant structure, such as roots, stems, flowers, and seeds. An outdoor thermometer may reveal temperature changes. Art work can be utilized in the study of changes.

A community of living things never remains in a strictly static

condition. Children can observe the changes in a weed patch near the school, in a thicket, or in a garden. There is a continual shifting caused by weather, seasonal change, and just ordinary life and growth within the cycle of new life, maturing, and death. All around children are evidences of change.

There is no exception to the occurrences of change even when man is involved. Natural forces are always present and working in an environment. Perhaps man can never control the natural forces. Rather he must learn to work intelligently with these natural forces to bring about changes which are advantageous to his best interest.

In addition, there are the great changes brought about by man's inventions and man's discoveries. Of course, children are not so aware of the significance of these changes as adults. However, the school must prepare children to meet change, for the next generation may need to be prepared for even greater changes than those met by the present generation of adults.

Man has lived through revolutionary changes in his social living because of the introduction of new forms of energy and of ways to utilize that energy. The discovery of fire, the introduction of animals to carry man's burdens, the steam engine, the electric generator, and the internal combustion engine greatly changed man's social and economic conditions. The utilization of atomic energy is bringing and will continue to bring tremendous changes. Children should gain a feeling of confidence in the fact that they are not the first of the human race to witness revolutionary changes in energy. Furthermore, it might be well for us to know how man's discoveries of new forms of energy have brought about great potential supplies of energy for everyone. The advances in the field of agriculture and soil culture may have significant impacts on the future course of world events.

Changes brought about in a community also may be significant. What did the country look like before the earliest settlers came in? What changes have been brought about by man?

There are only about one hundred elements which enter into combinations and form the multitude of substances about us. Chemists find that some of these elements combine in so many different ways that to date they have been able to make but a small proportion of all the possible combinations. Chemists are learning to build out of cheap sources substances which in their natural states have been very rare. They have also learned how to make new substances, such as new drugs, insecticides, medicines, plastics, synthetics, and so on. In this way, science contributes greatly to an improved health, finer recreation, and higher standard of living.

Life Is Adapted to the Environment—Adaptation

Adaptation is a pattern which permeates the entire realm of living things, for wherever there is life there is adaptation. This is a conception of great significance in the modern world. Indeed, man's problem today is to adapt his social, economic, and political structure to the conditions of the environment and his own needs. In the early grades children can learn something about the homes of some animals and their adaptation to life in various places. They can be introduced to the idea that animals' structures have become modified to fit their environment. Later they can learn how plants and animals, including man, are adapted to seasonal changes. The study of prehistoric life is a story of adaptation, and can be supplemented by a study of how animals are protected against their enemies, how animals take care of their young, and how plants continue to live on the earth. Man adapts himself through community life. The advantages and disadvantages of this form of adaptation, along with a study of solitary animals, may be considered on intermediate levels. As the child matures the scope of his concept of adaptation is further broadened through a study of prehistoric modifications, of the weapons which animals use, and of the struggle for existence.

The conception of this pattern, like the conceptions previously outlined, may influence an individual at all levels of his development. It may modify the child's interpretation of simple observations of the effect of seasonal change on plants and animals. It may give substance to the youth's understanding of the structural variations of living things, and to his consideration of problems of public welfare. It may determine the adult's participation in politics and in public forums. The scientist finds much that remains to be discovered concerning adaptation. The significance of this conception in the social studies can scarcely be over-emphasized.

Some of the more general facts involved in understanding the concept of adaptation are the relationships of living things to temperature, water, food, light, gravity, and certain gases found in the atmosphere; the effect of some of the limitations of these conditions upon life; the narrow range in these conditions on the earth as compared with those found in the universe as a whole; the adaptations imposed upon plants and animals that live under these conditions; the prolificness of life; and the interchange of energy and substance between plants and animals and between the physical environment and living things. Through experimentation, discussion, and reading, children learn that living organisms need light, oxygen, nitrogen, carbon dioxide, heat, water, and other conditions in order to exist and to produce young. When some of these things are scarce or too abundant, life may suffer.

The implication for international understanding is that man frequently is limited by the physical conditions of the environment to which he adjusts himself. Some people must live in inhospitable places, such as swamps, deserts, and arctic regions. These people must utilize the materials that are available for shelter, food, and clothing. It is not surprising, therefore, to find among the peoples of the earth a wide variety of customs. Many of these customs which seem foolish to others may be the results of the experiences of many generations in a given environment and may be necessary to the survival of that people.

International co-operation has become a necessary adjustment on the part of mankind if our culture is to survive.

In science studies in the elementary school, children have an opportunity to realize that man is only one of a multitude of living things, and that, like these other things, he has survived because he has made adjustments and adaptations to the environment.

The Variations of Living and Nonliving Things—Variety

On the earth there are wide varieties of climate exhibiting differences in mean temperature, in the range of temperature, in the length of the growing season, in the amount of rainfall and its seasonal distribution, as well as differences in exposure, in slope, in drainage, in elevation, and in soil. These factors create many kinds of environments and require adaptations to these environments. All around us we see in nature a variety of forms, differences in structure, sizes, habits, and life histories of plants and animals. They range from the ultramicroscopic organisms to the gigantic forms of the redwoods and whales. The life span of some living things is very short, while that of others covers several hundred years.

When we see how many different kinds of living things there are, it is not surprising to find that there are also so many different kinds of people. Man has wandered about the world for thousands of years, living in many habitats widely separated from each other. We should expect, therefore, to find different races, languages, and customs, but a concept that science may teach is their interdependence despite their differences.

No two living things are exactly alike, although they may be of the same species. We cannot, therefore, judge all people of any nation on the basis of one or two we may have known.

Variation is manifested in the physical world as well as in the biological. There are many systems of organization in the physical world—the atom, the element, the molecule, the compound, the substance, the planet, the solar system, the galaxy. There are many kinds of minerals,

soils, and rocks. There are only around one hundred elements, but there are thousands of different compounds. There is variety in the manifestations of energy. Man, too, tends to develop variety of forms in his inventions, discoveries, engineering, and arts.

Children should become acquainted with this theme by being introduced to the range and scope of certain obvious characteristics in the physical and biological aspects of nature. Instruction should be chiefly concerned with the theme rather than with mere identification of animate and inanimate objects.

Each child has two parents. Each parent brings to the child a diverse inherited background. When we consider that this means for each child four grandparents, eight great-grandparents, and so on, the tremendous potentialities working for variation in the human race become apparent. When to this observation we add the fact that each child has a different environment, the tremendous variations found in children in any classroom are understandable. Every individual is a result of success through a long span of years in that each of his ancestors is the result of two parents reaching maturity in spite of sometimes hazardous conditions.

The concept of individuality, that each individual is unique and different from all other individuals, is a part of the larger pattern of variety. Williams,[1] a biochemist, has recommended that we should start teaching children in the kindergarten that they possess individuality. His recommendations merit serious consideration by elementary-school workers. They point to one way in which science can contribute to mental hygiene. Each individual has a right to be different. He should not be amazed to learn he is superior to some of his classmates in some ways and inferior to others in other abilities. This pattern can be used to develop a feeling for the dignity of the individual, a feeling so important in a democracy.

Following are some of the aspects of variations that are illustrative of those found in the environment of children:

Changes that take place in the out-of-doors.

The many different kinds of animals.

The variety of animal noses, eyes, tails, mouths, coverings, legs.

The variety in prehistoric animals.

The different ways in which animals move about.

The differences in animal homes, such as those on the desert, in the arctic, in swamps, underground, in fresh water, on the seashore, in the ocean depths, in the forest, in the meadow, in trees.

[1]Roger J. Williams, *Free and Unequal: The Biological Basis of Individual Liberty* (Austin, University of Texas Press, 1953), p. 177.

The variety in locomotion, food-getting, breathing, and protection of animals.

Different ways in which animals grow up.

The many different kinds of plants, such as those that develop from spores, those that develop from seeds, those that are annuals, those that are biennials, those that are perennials.

The animals that are social, and those that are solitary.

The animals that are cold-blooded, and those that are warm-blooded.

Interdependence of Living Things—Interrelationship

A theme which is practically universal in character is interrelationship. We see the significance of interrelationships as an integrating theme in many of the forces operating on the earth, for example, in the description of astronomical bodies, weather, and other physical phenomena; in the interdependence and interrelation of living things to each other and, in turn, to their physical environment; in the causes of ill health; and in the relation of pests and parasites to economic loss in the agricultural world.

Space does not permit a full discussion of how the idea of interrelationships in physical and biological phenomena may be developed. In the early years children gain experiences which lead to an understanding that some plants and animals in the garden are harmful. In later work they learn the value of certain other plants and animals and what people are doing to protect them. Attention should be focused in later elementary-school work on the problem of conservation and on preparing pupils for a more comprehensive study of the biological principles involved in the struggle for existence, in the balance of nature, and in the interdependence of life. Some of the relationships of scientific discoveries and inventions to man's progress and welfare should be considered. Man does not live to himself alone. He lives in a world of interdependencies and interrelationships. He is dependent upon earthworms and plants for the fertility of the soil. He is dependent upon birds to keep insects in check. He needs snakes, owls, hawks, and other animals to keep rats and mice in check. Spiders serve to control the number of insects. An animal which seems rather insignificant to us may play an important role in the development of conditions suitable to man.

The interdependence and interrelationships of living things to other living things and of living things to the physical environment is basic to the understanding of social issues. Physical and biological forces do not recognize national borders. A wind blowing in one country may be due to world-wide atmospheric conditions and the pressure of air in regions

within the borders of other nations. Animals do not necessarily stop at national borders unless those borders are natural barriers, and even then certain animals are known to cross many such barriers.

In science the earth must be considered commonly as an entity; a disturbance in the physical or biological world in one part of the earth may have significance to many other parts. In a community a fire in one section is the concern of the entire community. A disease or a pest in one section of the world may become the concern of all peoples. Nations, therefore, should learn to work together in an intelligent way for the welfare of all peoples of the earth.

The natural resources of a country, such as soil, oil, coal, gas, forests, and pastures, are the result of natural forces operating for millions of years. People have not created them, but they frequently waste them through carelessness and mismanagement. Man can waste in a generation or two what has been the result of titanic natural forces operating over long periods of time.

Man, if he is to remain civilized, must disturb the original balance of nature, for only savagery can exist where man does not attempt to make changes. But it is man's task to use the natural processes and resources in such a way that he secures what he needs for a high standard of living without hazarding the welfare of future generations. Man need not return to savagery nor disregard natural resources; he now has science to use in planning for the years ahead. It is incumbent upon the public schools to develop a generation with ability to meet its problems, both personal and social, with intelligence, co-operation, and resourcefulness. This calls for an appreciation of the interdependence of living things, and of the interrelations of living things and the physical forces and materials.

Balance and Imbalance—The Interplay of Forces

As one observes the many events or phenomena in his environment one is impressed by the dynamic flow of events and the energy involved in them. If one could be an observer over centuries, one would be aware of the titanic forces in operation; but seen one day at a time over the short span of a human lifetime these forces often pass unrecognized. Some, such as evaporation, seem small; yet scattered over the face of the earth, evaporation is tremendous and results finally in rain, snow, dew, frost, weathering, erosion, floods, blizzards, and other events.

There seem to be tendencies toward equilibrium and balance in the operation of forces. In a normal atom it is thought the positive electrical charges balance the negative electrical charges. It is thought that

a static electrical charge is the result of an imbalance in these electrical charges. The shock we feel or the lightning flash we see is the resulting establishment of equilibrium of these charges. Even the thunder can be thought of as a clap caused by air rushing in where the air was expanded by the heat of lightning.

We have already spoken about the balance of nature. Man has been ruthless at times with this balance and has experienced economic loss from the resulting dust bowls, soil erosion, waste of resources, epidemics, plagues, and pests.

There are forces operating also in the structure of the earth. It is thought by some geologists that in maintaining balance these forces have caused the formation of mountains, continents, and oceans. We witness earthquakes and volcanic eruptions as a part of the balancing of the earth's structures.

It should be kept in mind that the sun is a great source of energy and that it shines on the earth all the time. It shines on the other side of the earth while we are having night. It shines when it is cloudy, although there are clouds between us and the sun. The sun then is like a great solar engine which furnishes energy for green plants to grow and make food, for water to evaporate, and for the movements of air currents or wind and of ocean waves. The movements caused by the sun's energy are checked and modified by the earth's gravity, its rotation, and to some extent by friction. There is a tremendous interplay and interaction of the forces in the universe.

Wherever we look we witness the operation of forces and the many evidences of balance. In our own efforts to maintain balance and equilibrium, we also experience the operation of natural forces in and on our own bodies. Many psychologists explain learning at all levels as a process of attempting to gain intellectual balance in the face of a new situation, a problem, or a challenge.

Conservation as a Pattern for Behavior—Developing Responsibility for Our Environment

As children develop a better understanding of the basic patterns of the universe they also may acquire more intelligent behavior with reference to natural resources, including human resources.

Some courses of study help to establish undesirable kinds of behavior, as when children are encouraged to develop collections which in turn can rob the environment. Sometimes they are instructed to bring to school collections of leaves, twigs, flowers, rocks, minerals, and bird nests.

We need to develop in children a feeling of responsibility for the

environment. Conservation, or intelligent use of natural resources, consists of a kind of behavior as well as a body of content. Before moving objects, animate or inanimate, out of the environment and into the classroom, there are many major considerations which the children may discuss. To whom does the object belong? Do I have the right to take it to school? Do I disturb the environment if I remove this object from it? Am I destroying the natural beauty of the environment by removing this? Is the study I am going to make of the object one which merits its removal from the environment? Should I plan to return the object to the environment as soon as the study is completed? Can this object be studied properly if it is removed from the environment? Can I care for it properly in the classroom? If it is alive, does it have a chance to live in the classroom? Am I prepared to give it the care it needs to survive? One should keep in mind that living things are usually found in an environment to which they are more or less well adapted.

Developing Behavior Consistent with Health, Economy, and Safety

Many schools are now integrating health entirely with science and the social studies. Science provides the necessary background for the teaching of health information and the development of good health habits; therefore, a program of science in terms of problems and meanings should offer opportunity for the integration of science and health.

The relation between science and economy has too long been neglected. Because of his own ignorance of the operation of biological and physical principles, man is at present beset by a host of problems concerning international economy. Recent projects in a number of countries are helping to solve these economic problems in local environments by re-establishing in the natural forces a balance in favor of man's interests and welfare.

The relation of science to the economic problems of man is well exemplified in his struggle with pests. Man has carelessly introduced exotic plants and animals into almost all regions of the world. Many of these transplanted plants and animals, unchecked by their natural enemies and competitors, have multiplied so rapidly that they have brought havoc to the economic life of the nation. Control comes not alone from the work of fact-finding public or private scientific agencies, but also from the intelligent co-operation of the entire population. Much can be done to secure this intelligent co-operation through an integrated program of education in the public schools. Mankind cannot afford to have another generation ignorant of the elementary biological principles of nature.

Another similar problem is to find ways to prevent loss of soil through erosion. In almost any section of the world we can find examples of the terrific loss of natural resources resulting from the lack of soil conservation. Creating an awareness of this problem in order to bring about intelligent individual and community action concerning it is no small part of science in the elementary-school program.

Many species of our indigenous plants and animals have become extinct because of man's ruthlessness and ignorance. Still others are in danger of being destroyed. Man cannot continue to be ignorant of the web of life in which he is by nature involved. The elementary school, as the tool of the common people, should work toward developing a generation concerned with the wise utilization of natural beauty and resources.

We cannot fully anticipate the environment of the future. New inventions may eliminate present hazards and create new ones, making it impossible for us to develop a code of conduct in safety instruction which will be functional for an entire life span. It may be well for us, then, in safety instruction, to place more emphasis upon scientific principles which are basic to safe conduct. Children at all levels should be encouraged to enter into planning with the teacher for safety on all excursions, including the short excursion, even though it may be only to the edge of the school grounds.

Consideration should be given to what one should do in case of fire or other disaster so that the behavior is automatic. Classroom teachers and parents can have a powerful influence over the destiny of whole regions and nations by developing in children a willingness and ability to base their conduct and behavior upon sound information. Safety education, as one aspect of the goals of conservation, can well be integrated into the development of responsibility for one's own behavior and for the environment.

A Variety of Procedures

The teacher should look to a variety of procedures in teaching science. It might be well to avoid dropping into routine methods. Discussion, instructional excursions, observations, experiments, reading, use of visual aids, group work, and planning all play a part in the teaching-learning situations in science education. The teacher should consider her own interests, tempo, and rhythm along with those of the children. It is important that the teacher be happy with the procedures. It is well for the teacher to be present as a participant in all the procedures. He should be a learner, for good teaching in science involves learning.

If there is one term that can be used to specify the kind of instruc-

tion appropriate to all phases of science teaching in the elementary school, it is "developmental." In this case it is developmental from the point of view of children and teacher, both as learners. It means the instruction develops, using the experiences and knowledge children may have or that can be provided for them. It is developmental in that children may participate in the development of the planning for the use of experiences, experiments, discussion, and authentic materials to provide solutions to problems. The new learning is made acceptable to the children by the nature of its development in instruction. Children are given time to internalize new learning, integrating it with their experiences and ideas. It is important in this development to provide opportunities for an idea to be tossed about in the thinking of a group, to be tested through simple experimentation, if appropriate, or through observation, to be talked about at home, and to be checked against authoritative books.

In any consideration of teaching methods, the primary concern in elementary education is what kinds of boys and girls are being developed. All of us need to be cautious that our procedures do not become devices and ends in themselves. Therefore, evaluation should be an integral part of instruction rather than something done at the end of a period of instruction.

At all times in teaching it is well for the teacher to know at what point the children are in a given development. In this Manual suggestions are given the teacher as to ways in which he can secure this information. It is well also to find out how the children think, that is, the type of thought structure they have. Such questions as "What do you think?" "Do you think so? Why?" "Why do you say that?" "How would you get the information?" "Do you think that is information we should accept?" will give the teacher evidence as to how children think and where they are in their development.

Regardless of how the instruction at any point is initiated, vital teaching recognizes the concepts children may have on a subject or problem. So it is well for the teacher to provide opportunities for them to express their ideas, however incomplete or inaccurate, in order that misconceptions may be brought into the open. It is most important that they be allowed to express themselves without the fear of censure or ridicule, although at times there can be the enjoyment of childish humor and fun without personal damage.

Very frequently children's concepts have originality and imagination. Their concepts also provide opportunities for evaluation of preceding work and reveal the kind of instruction needed for the clarification of ideas. The authors of this series have profound respect for the natural

ideas developed by children. Every child needs an adult who will sympathetically and intelligently listen to him. If such a person could be provided for more children, we would need fewer corrective institutions.

Studying Children while Teaching Science

Teachers will find their teaching enriched if they will study children as they teach. Science with its challenging content and its rich contribution to the attitudes and behavior of both adults and children offers unique opportunities for the study of children.

The greatest concern in studying children is not how much information children have secured, important as that may be. Rather, the main emphasis should be on what kind of boys and girls we have. What kind of thinking do they do? What are their outlooks upon the world? Are these outlooks constructive and democratic? Do the children think for themselves? Are they developing good ways of thinking? Are they learning to be resourceful?

At all times teachers should be alert to the kinds of behavior changes that children are making. The teacher may ask: Are the children developing dogmatic attitudes, or are they willing to consider new ideas? Are they tending to accept every idea they hear without hesitation? Do they look for further evidence before drawing conclusions? Are they learning to use authoritative books? Do they report on out-of-school experiences in a wholesome way? Do they propose explanations? Are they learning to plan? Will they work with others?

In this kind of study it must be recognized that behavior may reflect the home and the general background of the children. A dogmatic parent may cause a child to be gullible.

It should be kept in mind that it is the behavior in which a child has had some degree of freedom of choice which is the most useful for evaluation. The closely worded or directed question of the quiz program and the rigid recitation have little significance in evaluating behavior. In a sense it is the spontaneous behavior of children—the proposal of something to do, the inquiry, the choice of language in indicating open-mindedness, the critical-mindedness, poise, resourcefulness, the challenge of a statement, the willingness to consider new ideas and to take on new duties, the use of old learning in new situations and learning—which is useful in evaluation. All of this seems to favor a type of discussion in science instruction which allows for freedom of expression and thinking.

It is recognized in this that teachers need to study children as individuals and as groups and from a total, rounded-out point of view of

education. The contention here is that science with its profound meanings offers unique potentialities in studying children from this view. Children should not be evaluated as if the development in behavior relating to science were isolated from all other aspects of their lives. Science, as the interpretation of the environment, should be thought of as an intrinsic part of the life of children in the modern world, a part that may be an important factor in building desirable behavior.

A Dynamic Education for Children

The preservation and advancement of democracy depends to no small extent on the behavior patterns developed in children. We do not know what the future will be. In a sense we must educate children for uncertainty. This does not imply that we need be pessimistic about the problems these children will face in the future. Rather, we can be confident that if we assist them to develop democratic and resourceful behavior, they will make their own future.

It is the contention here that the outlook of children toward their environment and universe is the very core of the development of a resourceful adjustment to the future. While incidents play an important part in making learnings meaningful, science should not be incidental in the lives of children. Instruction limited to talking about science and a description of objects and events is not in keeping with the dynamic urges of children and will not serve to help them cope with the problems of today and tomorrow.

There is a need for a positive and dynamic program for children, one which develops a feeling on the part of children of being needed by our democracy, in times of peace as well as war. Children are needed not alone for their own nation but to assume responsibility for work toward a better world.

There may be opportunities for children and teacher to work to improve conditions in the classroom, in the school, on the school grounds, and in the community. In this way, they can see how science is used.

Science will continue to play an important role in the lives of our children. It is a powerful tool which can be used for good or evil; and children, the adults of the future, will have to decide which way it shall be used.

It is most important to the success of our way of life that children have a favorable attitude toward science. Science should not seem foreign or exotic to them. Science viewed as the result of the age-old drive of man to adjust himself to his environment and to maintain his own equilibrium in the welter of biological and physical forces carries

with it a larger point of view than a purely vocational one. Science is the result of man's experience and logical thinking through the centuries. Science, like democracy or the mother tongue, belongs to all who wish to make use of it. Children should be made to feel that science belongs to everyone.

Science instruction should be a pleasant experience for both teachers and children. Teachers should feel relaxed with children while teaching it. Interest in science should be maintained at all levels. The instruction should be freed of assignments involving busy work and meaningless drudgery. Exhaustive and overly specialized units should be avoided.

Boys and girls must learn to handle and to experiment intelligently with the forces and materials of the universe. Unintelligent tampering and carelessness bring disease, ugliness, waste of natural resources, unemployment, poverty, war, and widespread unhappiness. Children must develop a poised, well-balanced, yet realistic outlook upon the modern world. They must learn that by working resourcefully and intelligently they can create their own world.

GERALD S. CRAIG

Purpose and Plan of *Science Around You*

What *Science Around You* Means to Children

Science Around You is the second-grade book in the series SCIENCE TODAY AND TOMORROW. The science experiences in this book are common to a majority of seven-year-old children everywhere. They make use of the tendency of children to touch, to see, to hear, to taste, to smell, and their other natural drives directed toward orientation to their environment. These experiences can be utilized to help children interpret their environment. Experiences suggested in this book have been developed according to the purposes of science in childhood education as presented in the Foreword of this Manual.

Science Around You points out the balance in many aspects of the child's environment. It is unique in its consideration of seasonal changes in several different regions. In the chapters on "Summer," "Autumn," "Winter," and "Spring," children will see that there are many changes in some places while there are few in others. These chapters are illustrative of a relatively warm region, such as the Gulf coast, the semiarid portions of Mexico, Canada, and the United States, and the temperate regions of the United States and Canada.

In other chapters children engage in firsthand experiences to see what is in the air and to learn how to interpret changing weather. They are given some simple and accurate explanations of earth and sky. They experiment with sound and find simple explanations of vibrations and how sounds help us.

Children are also helped to understand rough and smooth surfaces, sliding and rolling friction, and how friction helps us. They are introduced to concepts of energy and work. They observe that moving things do work and that things are moved by people, wind, water, springs, steam, gasoline, and electricity.

Science Around You also contributes to an understanding that certain things need care, such as soil, animals, and machines on a farm. Children will discover that leaves, trees, and soil help to make good farm lands.

What *Science Around You* Means to the Teacher

The Manual supplies help for you in teaching science to second-grade children. No special science education is necessary to use *Science Around You* or the Teachers' Manual. You can use these books and learn with the children as you teach. The authors suggest that you read the Foreword and this section of the Manual before beginning the use of the textbook.

Teachers should have no hesitation to teach science. It is the hope of the authors that every teacher will feel at ease with the children while using *Science Around You.* Science should be a pleasant experience for the children and the teacher. The teacher need not feel that she has to know answers to all the questions that children raise. It is no longer the teacher's function just to answer questions. The teaching of science in the modern sense is work and study with children. There will be times when a child, because of his experiences or family background, may know more concerning some subjects than the teacher. The teacher need not feel chagrined at this. Rather she should capitalize on the child's experience, turn it to use in the classroom, and occasionally help him to check his information for accuracy and to develop it into richer meanings.

Developing Science Concepts

Children face the task of acquiring concepts adequate for intelligent thinking and acting in our modern times. Wise teacher guidance helps them face this task. *Science Around You* and the Teachers' Manual suggest many experiences that reveal the raw materials of sensory experiencing.

Children learn through the sensory experiences of feeling, hearing, seeing, tasting, and smelling. They experience friction, energy, and gravity when they walk, run, jump, and move objects. They have firsthand experiences with the changing seasons and weather. They see rust on objects. They see decayed materials. Children learn to manipulate mechanical objects and see how machines do work. They hear sounds and may be able to tell what is vibrating. They notice changes in the day and night sky. They sense time and space through their own activities and those of others around them.

As children have firsthand experiences they see the common elements in them. They talk about experiences and attach words to them. They may read a printed page to get further meaning. With help they may express some of these experiences in written form. With more experiences the children make greater use of printed words, see more common elements and relationships, and make still larger generalizations. Such generalizations are their own conclusions stated in a childlike language. In this way concepts come into being as children mature and gain experience.

For example, a child plays in a sand pile at two or three. When he is older, he digs in the soil and finds small rocks, maybe an earthworm, tiny living plants, and other things. He notices many colors in soil. Still later he may rub rocks together, discovering that soil, in a large part, comes from rocks and that it takes a long time to make soil. At

about the second-grade level he may examine leaves and watch them turn brown, wrinkle, dry, break up, and decay. He attaches words to these experiences through speaking, listening, reading, or writing all along the way. From experience to experience he generalizes. He begins to generalize that many things and conditions are needed to make good soil.

As children use *Science Around You* they will see the relationships between facts. As they see these relationships many times they will tend to form science concepts appropriate to their level of maturity. Thus children can become more adequate. They are better able to make interpretations of the environment around them and not merely describe events. Their interpretations show that they understand the reasons for what they see, do, and say.

Children develop richer meanings by observing and giving their own explanations.

Helping Children to Interpret Their Environment

Much of children's interpretation of things around them comes from experience. Their interpretation of an experience continues to develop a direction rather than stops with the learning of isolated facts. As has

been pointed out, the direction of interpretations changes at different age levels. For example, over a long period of time and through many experiences children come to understand something about the *interrelationships* of living things and soil, and that it takes a long *time* to make rich soil.

On page 4 of *Science Around You* a variety of plants is pictured. Some of the plants grow in or near water while others grow under different conditions. You might look out your classroom window and see a great *variety* in living and nonliving things. You may see variety in rocks, soil, clouds, weather, machines, people, plants, and animals. There is variety in the kinds of plants and animals you see on a desert, in a schoolyard, on a hillside, in a valley, along a garden fence, in a pasture, or in a swamp. There is great variation in our world.

In the chapters on "Autumn," "Winter," and "Spring" children will gain ideas about the ways in which animals are adapted to survive seasonal change. Some animals migrate while others hibernate during cold winter days. Plants are adapted to seasonal changes, thus enabling a species to survive. You probably will not need to use the word *adaptation* with children, but their interpretations of living things around them will reveal that their understanding is moving in the direction of this larger pattern of our universe.

It has been said: "The large patterns of the universe, such as space, time, energy, change, adaptation, interrelationships, variety, and balance are patterns of growth and development from the cradle through adulthood. These will not be mastered in our time, and perhaps not in a thousand years, by scientists, but research indicates children can begin to adjust to the large patterns before they enter kindergarten. Man's success on the planet is dependent upon his ability to co-operate intelligently with the great forces and patterns of the universe."[1] These large patterns are discussed in the Foreword of this Manual.

Following are examples in the Manual of clues to the direction in which children's experiences and interpretations may be moving in terms of the larger patterns of the universe:

Variety

Observing Many Kinds of Plants, page 19
Observing Animals Outdoors, page 22
Observing Seeds Outdoors, page 38
Seeing Many Kinds of Clouds, page 54
Seeing Many Kinds of Nests, page 114
Digging in the Ground, page 121

[1]Gerald S. Craig, "Index to the Future," *Science for Today's Children*, Thirty-Second Yearbook Number, Department of Elementary Principals (National Education Association, 1953), Vol. XXXIII, No. 1, p. 293.

Adaptation

Examining Leaf Buds, page 38
Discussing Winter Animals, page 88
Investigating Hibernation, page 90
Examining Bulbs, page 117

Balance

Using the Outdoors Wisely, page 37
Using a Park Wisely, page 118
Planting Young Trees, page 158
Seeing Some Value in Weeds, page 159

Change

Discussing Changes Made by Insects, page 40
Recording Changes in Weather, page 58
Discussing Night and Day, page 69
Seeing Changes in the Spring, page 112
Observing Changes Around School, page 115
Watching Changes in a City Park, page 117

Conditions Necessary for Life

Interpreting Sky Conditions, page 23
Discussing Dry, Hot Places, page 24
Discussing Changes Made by Insects, page 40
Getting Water to Dry Places, page 118

Energy

Experimenting with Shadows, page 70
Experimenting with Sounds, page 99
Discovering Vibrations, page 101
Moving a Heavy Box, page 128
Experimenting with Rollers, page 129
Making Use of Friction, page 130

Interrelationships

Observing Smoke in the Air, page 52
Seeing Different Habitats, page 114
Preventing Soil from Washing Away, page 116
Making a Garden and Watching Changes, page 121

Space and Time

Using a Globe, page 25
Looking Far Away, page 65
Estimating Time and Distance, page 66

Helping Children to Think

Sometimes the behavior of children is impulsive. Sometimes they give quick opinions, make snap judgments, and act with little forethought. But this behavior is natural for children, and what they do and say should be respected by adults. Children should never feel penalized during science experiences because of ignorance. Their misconceptions should be treated as an opportunity to help them think.

Co-operative planning can help children become more reflective. It can help them learn to act more wisely. As you offer explanations and interpretations you can help them to think more objectively.

If children are to mature and to learn how to think in a more objective way, they will need:

Help in sensing and stating problems or questions. (See examples in Manual, pages 22, 52, 68, 140, and others.)

Encouragement in suggesting and stating hypotheses. (See examples in Manual, pages 38, 52, 89, 99, 129, 141, and others.)

Suggestions about ways of getting information by observing, experimenting, and reading. (See examples in Manual, pages 19, 23, 39, 69, 88, 92, and others.)

Guidance in making and checking conclusions. (See examples in Manual, pages 26, 40, 54, 70, 100, and others.)

Young children may not use these procedures in a logical way, step by step, nor will they use them on all occasions. They can, however, use some elements of the scientific method as you guide their thinking and experiences along these lines. It has been said: "The process (the scientific method) of getting the best statement of truth available should be a process that is made clear to children at an early age."[1]

Using the Teachers' Manual for *Science Around You*

The purpose of the Teachers' Manual is to give suggestions for using *Science Around You*. You should use the Manual as much as you wish, modifying suggestions in the light of your knowledge of the children within your group and of the opportunities afforded by their own environment, of school policies, and of existing requirements.

For each chapter of *Science Around You* the Manual will follow the same outline in presenting suggestions for ways to make the chapter most useful to the children. At the beginning of each corresponding chapter in the Manual are clues for understanding the behavior of children. This section also suggests ways for child study through their science

[1]Gerald S. Craig, "The Development of Science in Elementary Schools," *Teachers College Record* (New York, Columbia University, 1948), Vol. 49, No. 6.

experiences. It will suggest your role as teacher in helping children to become more adequate in interpreting their science experiences.

Science Meanings for Children

In this section are listed the science meanings upon which to focus in order to develop the concepts in the chapter under consideration. Later, in a page-by-page development of each chapter of *Science Around You*, these meanings, as well as a few other related ones, occur as headings in the right-hand margin.

These statements, or meanings, of science concepts are *not* to be used directly with children. However, children may generalize or express their conclusions in a somewhat similar way in their own childlike language. The science meanings will guide you in the development of the larger patterns or principles of change, adaptation, variety, space, time, balance and imbalance, and interrelationships discussed in the Foreword.

Information for the Teacher

This section in the Manual will develop more facts than will be used with the children. It will put the science meanings, or concepts to be developed with the children, into a larger context of explanations and interpretations for you. You will also find *Science for the Elementary-School Teacher*, by Gerald S. Craig, helpful in extending your background of information. Other sources of information are indicated in the bibliography at the end of each chapter.

Ways of Working with Children

Children may use *Science Around You* for different purposes. Among these purposes are the following: to find information, to solve problems or questions, as a guide to further study, or to help in beginning a new piece of work. This section of the Manual will help you in using the text and illustrations, carrying on discussions, making observations, doing experiments, recording, and evaluating.

Discussion · Children must have freedom in discussion to ask questions, state problems, make explanations or hypotheses, state reasons, and check facts, opinions, and conclusions. The Manual for *Science Around You* will give suggestions on how to do this through such questions as:

How do we know this to be true? How may we test it?
How may we find out?
How may we be sure?
How may we show that what we say is true?

Ample time should always be given for children to discuss their own firsthand experiences which are related to those shown in an illustration. Each illustration is an integral part of the text under consideration and will clarify and reinforce ideas. Effort should be made to help children recognize and interpret the science meanings being developed. Such discussions will reveal that they are getting a feeling for or moving in the direction of the larger patterns of adaptation, time, space, variety, balance and imbalance, or interrelationships discussed in the Foreword.

Sometimes the illustrations offer suggestions for science experiences and show materials needed to try them in the classroom. Sometimes they suggest a place outdoors for you to visit for a similar firsthand experience.

The illustrations will afford opportunities for the children to discuss science ideas before reading the printed words. Encourage and listen to their spontaneous comments. Discussion of the illustrations will help you to use the new science words naturally in conversation before the children begin the reading. Thus these new science words will be in the child's speaking vocabulary before he reads them. Wise use of pictures helps to develop science concepts.

Children's spontaneous comments will be of great value to you. You will need to listen to their ideas. Through discussion and use of an illustration the children will reveal what they already know about a subject. This will give you clues as to what you may expect to build on. From time to time the group may actually list what they already know as you write their statements on the blackboard. Such a discussion could naturally lead to planning what the children wish to find out or do.

Children need to begin the art of participating in discussion. The ideas of children should always be respected. It is well to remember that good questions can be as valuable as statements of fact.

Discussions need to be guided and to have focus. Following are examples of topics that illustrate needs for discussion:

Stating Questions and Problems, page 22
Stating Proposals or Hypotheses, page 38
Using Questions, page 39
Giving Explanations and Interpretations, page 53
Listening to Explanations, page 77
Challenging Thinking, page 101
Avoiding Gullibility, page 103
Reviewing and Using Facts, page 103

Experimenting · This Manual and *Science Around You* suggest many firsthand experiences and simple materials that may be used to test

ideas. Strictly speaking most of these are not real experiments, but experiences using simple materials. Genuine experiments are carefully controlled. They are developed under certain known conditions. Thus the results of an experiment can be relied upon. Children "experiment" to solve a problem when they do not know the solution, but because conditions are not controlled, they may not find the right solution. However, many science experiences help children to investigate and to think more objectively.

The following topics illustrate examples in the Manual of experiences using simple materials and of ways you can help children to think more objectively:

Learning How to State Hypotheses, page 19
Experimenting Again to Check, page 52
Testing Facts by Experimenting, page 56
Experimenting to Clarify Ideas, page 69
Experimenting with Shadows, page 70
Experimenting to Show Reasons, page 79
Checking Hypotheses by Experimenting, page 99

You can help children to think more objectively by encouraging them to check the results of their experimenting. One way for them to check is to do the experiment several times and see if they get the same results each time. Observing a situation more than once is another way to check conclusions. Whatever the experience is, help your children to check it in order to be sure that they have the best statement of truth possible.

Reading · Think of reading as reading and discussion. Try not to feel too hurried. Through discussion and use of the illustrations as previously described, you can encourage children to tell about their past experiences, use in their conversation new words known to be in the selection, or list questions or problems to be solved.

The science meanings listed for each chapter will help you to focus on the specific science concepts to be developed. These concepts should be in mind as you guide the discussions before reading.

You will want to help the children have a pleasant and successful reading experience. Their reading should be guided by some purpose. It may be a question or a problem, preferably the children's. You should not hesitate to guide the reading with your own questions, however. At this time you should also give any needed help with words. Emphasis should be on getting the meaning of the ideas being developed in the selection. More specific suggestions for guiding the reading will be given in the page-by-page development.

It has been the authors' experience that children like to use science words. For example, many children like to use *evaporate, vibrate,* and *hibernate.* You should work toward the development of the concept of a word. All the new words used in *Science Around You* are listed on pages 12–13 of this Manual.

Rereading is done for a new purpose or to find a fuller meaning. Rereading for a new purpose may be done to clarify differences of opinion, to give reasons for opinions, to clear up misconceptions, to avoid gullibility, to give further evidence, to check an explanation or hypothesis, to check observations, to follow directions for an experiment, or to check conclusions.

Using the information in the selection in some way is essential. Many pages in *Science Around You* address one or two questions to the reader. Here are a few examples:

Page 7—How do plants around you get water?
Page 35—How do you see thermometers used?
Page 68—Do you know any animals that hibernate?
Page 77—Do you live in a place of many changes?
Page 118—Can you experiment to find out?
Page 121—How does electricity work for you?
Page 135—How can you keep things from rusting?

The purpose of these questions is to help children relate the selection to their own experiences and the environment around them. In discussing the questions, the children should use their own firsthand experiences freely. This step in reading may lead to further observations or experimentation.

Further Experiences

Reading and discussion of the various selections in *Science Around You* may arouse new interests or call for more activities than space in the book permitted. This section in the Manual will provide opportunities to develop more firsthand experiences.

The experiences in this section of the Manual may also meet the needs arising from individual differences among members of the group. The range of interests and individual differences may be as great in science as in any other subject. Children with less language or reading ability will need more firsthand experiences. With your help they may record science experiences and use these as experience reading charts. Some children may go further with the selection being studied by using these suggestions and reporting findings and conclusions to the entire group. Research reveals that gifted children with a high general intelligence are often interested in science.

Evaluation

Children's science experiences afford opportunities for child study. A desirable way to evaluate progress is to observe the behavior of the children. Does the individual question magic as an explanation of events? Is he willing to consider new and reliable information? Does he make a distinction between fact and fiction? Does he reject personification, or reference to animals and plants as if they were capable of thinking, reasoning, and planning? At more specific places in the Manual these and other questions will be asked to guide the teacher in evaluating the progress of the children.

Science in childhood education gives opportunities to make use of the scientific method and to make it meaningful to children. You will want to watch for evidence of children's progress in using these elements of the scientific method.

What evidence do you see of the individual stating problems?
Does he make hypotheses or give explanations?
Does he suggest ways of testing his proposals?
Does he make conclusions?
Does he check conclusions with authentic materials?

Other means of evaluating progress in science are suggested, such as using the new information to plan and give programs for other groups of children, noting ways to organize and use science experiences, working with a variety of art media to record meanings from experiences, and making group or individual records of science experiences.

As you use each selection with children you may wish to observe how their ideas change and improve. Do they grasp the important concepts with which the chapter deals? What evidence have you that individuals have gained some understanding of the larger patterns of change, space, variety, or others? Do you see an increasing interest along certain lines? Do you see evidence of willingness to listen to suggestions, to discuss, to observe, to manipulate materials, and to check opinions and conclusions? Do you see evidence of changes in individuals as well as in the group as a whole? More specific clues to child study through science experiences will be given in the section on evaluation in each chapter.

Bibliography

At the end of each chapter there is a bibliography which the teacher may wish to use in extending her own background in science. Some books

are also listed for use with the children. Addresses of book publishers named are listed in the Appendix.

Audio–Visual Materials

You will find at the end of each chapter a list of films and filmstrips for use in the classroom. Each film or filmstrip should be previewed by the teacher in order adequately to guide children's understanding of it. Children should know what to look for before viewing a film. If part of a film is above the level of comprehension or unrelated, children should understand that they are not to be responsible for such information.

There are film libraries in nearly every state conducted by departments of education, state agencies, some universities, public libraries, and museums. Information about them can be secured from the teacher's own department of education. There is also a directory of national film distributor and rental agencies in the Appendix.

The Vocabulary List of *Science Around You*

Science Around You follows the book *Science Near You* in the series entitled SCIENCE TODAY AND TOMORROW. It is designed for easy reading by pupils who have reached the second-grade level. The total vocabulary of this book is 439 words. Of these, 257 are introduced in *Science Near You* or in the first-year program of the GINN BASIC READING SERIES. These 257 words are assumed to be known to children in the second grade.

Science Around You also uses 182 new words necessary to the development of science concepts. The 77 starred words in the list of new words are found in the second readers of the GINN BASIC READING SERIES.

No more than three new words are introduced on any page and each word is used a minimum of three times. All variants of known words are counted as new words except those formed by adding *s, es, 's, ed,* and *ing,* and compound words of which the two parts are known.

The new words are listed below by pages. The words assumed to be known are listed alphabetically.

New Words in Science Around You

4 summer*
5 . . .
6 much*
less
7 often
roots
8 hot*
very*
9 . . .
10 ditches
11 . . .
12 autumn
woods*
meadow
13 leaves*
falling*
belong
14 leaf
buds
small*
15 Bob*
through*
winter*
16 . . .
17 well*
watch*
18 caterpillar
cover
before*
19 butterfly
chrysalis
20 birds*

fly*
lose
21 south
later
flocks
22 use*
carpet
hole*
23 sounds*
24 weather
25 city*
high*
above
26 dust
clean*
Bill
27 smoke*
dirty
28 poured
asked*
29 leaks*
evaporates
30 pitcher
cooled
tiny
31 jar
top*
32 low*
33 dark*
more*
than*
34 freezes
35 thermometer
tells*
36 record
each*
few
37 afternoon
during
quickly*
38 melt
shining
tray
39 slowly
table*
40 earth
large*
Jim*
41 park*
cars*
lake
42 only*
cities
43 ocean
44 round*
rode*
ship
45 or*
46 . . .
47 keeps*
starts*
48 . . .
49 shadows
sunny
50 should*
51 any
52 . . .
53 heats
hotter
stove*
54 east
smaller
west
55 . . .
56 larger
57 cloudy
58 bright*
59 . . .
60 fluffy
61 . . .
62 last*
63 . . .
64 . . .
65 . . .
66 nuts
coats*
fur
67 dead
alive*
hibernate
68 below
frozen
safe
69 colder
north
fluff
70 . . .
71 year
72 . . .
73 pine
most*
evergreens
74 Sandy
75 forth
76 . . .
77 . . .
78 beat
drum
finger
79 strike
ears*
80 spoon
swing
string
81 louder
bell*
82 clock
ticking
loud*
83 end*
stick*
better*
84 vibrate
cymbals
together*
85 push*
button
rings
86 noisy
87 . . .
88 . . .
89 . . .
90 . . .
91 getting
longer*
92 rest
93 nests*
94 lay*
tap*
95 feed
96 . . .
97 . . .
98 . . .
99 . . .
100 . . .
101 . . .
102 . . .
103 turning
bulbs
104 sparrows
105 . . .
106 . . .
107 . . .
108 . . .
109 . . .
110 friction
paper*
111 rubbing
rubs
112 try*
113 pulling*
heavy*
114 roller
115 brakes
wheel*
116 . . .
117 . . .
118 . . .
119 . . .
120 . . .
121 tracks*
electricity
122 strong
sails*
123 pumps
124 . . .
125 . . .
126 powerhouse
machines*
wires
127 . . .
128 steam*
boils
129 gasoline*
130 . . .
131 . . .
132 . . .
133 . . .
134 horses*
135 iron
rust
nails*
136 deer*
137 . . .
138 . . .
139 . . .
140 . . .
141 forest
142 country*
143 . . .

Words Assumed to Be Known

a
about
after
again
air
airplane
all
an
and
animals
are
around
as
at
away
back
ball
barn
be
bees
Betty's
big
blowing
boats
book
box
boy
breaking
bring
brook
brown
build
but
buzz
by
call
came
can
candle
care
changes
children
clinkety-clank
clouds
cold
colored
come
could
cows
cup
cut
days
did
do
doors
down
drops
dry
eats
eggs
engine
experiments
far
farm
farmers
fast
faster
father's
feathers
feels
find
fire
floor
flowers
food
for
found
frogs
from
garden
get
gives
glass
goes
gone
good
grass
green
ground
grow
had
hair
hard
has
have
he
hears
helps
her
here
hide
hills
him
his
hold
homes
houses
how
I
ice
if
in
is
it
kind
know
lands
let's
light
like
listen
little
lives
long
looks
lost
made
make
many
Mary
may
mills
Miss
moon
morning
Mother
moved
must
my
near
need
never
new
next
night
no
noise
not
now
of
oh
old
on
one
open
other
our
out
over
part
people
picture
places
plants
play
pond
put
rains
ready
red
ride
river
rocks
roll
rough
run
said
sand
saws
school
see
seeds
seen
she
show
side
sing
sky
sleeping
smooth
snow
so
soft
soil
some
soon
splashes
spring
squirrels
stay
stops
stored
streets
sun

take
that
the
their
them
then
there
these
they
things
thinking
this
time
to
Tom
tomorrow
too
took
toys
tractor
train
tree
trucks
turtles
two
under
up
us
walk
want
warm
was
washed
water
way
we
were
wets
what
when
where
which
white
who
will
wind
window
with
work
yellow
you
young
your

I

Summer

The first chapter in *Science Around You* is "Summer," and you may wish to consider it in relation to the chapters on "Autumn," "Winter," and "Spring." The plan of these chapters is to reveal some of the conditions of the changing seasons in several places in North America. The chapter on "Summer" discusses the north temperate region where Mary lives as well as a semidesert area where Tom lives. "Autumn" deals with a place of many seasonal changes. The chapter on "Winter" shows many changes where Mary lives, and Sandy's warm winter place. The chapter about "Spring" shows a region of many seasonal changes, Sandy's place in a region of few changes, and Tom's place near a desert.

It is recognized that neither children nor teachers may have experienced summer in different kinds of places. The authors are giving a broad background for the study of seasonal change. You should develop the idea with the children that seasons vary in different parts of the country and of the world.

The chapter on "Summer" in *Science Around You* makes a good starting point during the first week of school. Encourage your children to tell about their summer experiences. You might ask: What did you do? What did you see? Such questions can start lively discussions of the out-of-doors. The children who have not traveled during the summer will have had other experiences to tell about. They may have been working in flower or vegetable gardens, watering plants, caring for pets, seeing new birds around them in the summer, watching the sky change, enjoying long summer days with longer hours of daylight for play outdoors.

Science Meanings for Children

You will be able to focus on some basic science meanings of the changing seasons, such as the appearance of the landscape, what plants and animals do in different places, changes in the work and play of people, changes in the temperature, changes in the forms of precipitation, and changes in the amount of sunlight. With guidance

your children will gain some feeling for the great variety of plants around them in the summer, that there are many animals, and that climates vary in different regions.

The following lists will help you to focus on some specific science meanings as you use the illustrations in the book, guide the reading of your children, observe the outdoors, or have other experiences:

In Mary's place—

There are many flowers in the summer.
There are many animals about.
Plants need water to grow.
It rains often.

In Tom's place—

There is little rain in the summer.
Water from irrigation ditches helps the plants to grow.
Farmers run water into the fields.
The water comes from far away.
Plants must have water to grow.

These science meanings will appear at the right-hand margin in the section "Ways of Working with Children." They are a guide for the teacher and are *not* to be used directly with the children. The children will state similar conclusions in their own childlike language.

Information for the Teacher

Seasons Change · There are four seasons during a year in most places where *Science Around You* will be used. Although each of these seasons is of about equal length, conditions, such as the amount of sunlight, the warmth of the air, and the amount of moisture, will vary.

Much sunlight comes to the earth during the summer. The temperature of the atmosphere then is fairly high. In most areas plants are active during the summer making food and growing rapidly. They make more food than they can use immediately. This excess is stored in various parts of the plants. By storing food the plants are able to survive during less favorable growing conditions. In dry places plants may not grow in summer. There the growing seasons may be autumn or winter, whenever the rains come.

Animals are very active in the summer. If there is an abundance of food, they may find it easy to obtain more than enough. They may eat much food and store some of the excess in the form of fat. Thus some animals become adapted to survive adverse conditions and may live for months without eating. Insects are usually numerous. Some species of birds are found even north of the Arctic Circle and some farther south than the Antarctic Circle during the summer months.

Many Kinds of Plants · Spring and early summer are the usual growing times. Some plants germinate from seed, grow, blossom, produce seeds, and die within a year. This is the life cycle that is repeated with such annuals as corn, oats, beans, and peas.

Some plants require two years to grow from seeds, flower, and produce seeds. This is the life cycle that is repeated with such biennials as beets, carrots, hollyhocks, and many of the clovers.

Some plants live for years, producing seeds each year after they have matured. This life cycle is repeated by such perennials as trees, shrubs, and many herbs.

Seeds become a means of the survival of plants as they reproduce other plants of the same kind. This is a concept of adaptation that you may help your children to discover.

Water and Its Importance to Life · Water is one of the most important factors determining the kind of plant and animal life in a community. The abundance or scarcity of water is probably more important than any other single factor. Mineral substances from the soil are dissolved in water and then taken into the roots of plants for use in making food. Most animals can survive longer periods without food than they can without water. The availability of water is an important factor in determining the kinds of plants and animals found together in a community.

Water is necessary to plant life for the food-making process and for the transportation of the manufactured food from one part of the plant to another. Plants have difficulty in surviving during a drought if there are too many plants in a given place, and some may die. Weeds seem to be able to survive drought conditions better than cultivated plants and often use water needed by other plants.

Water is present in the atmosphere in different amounts. Under certain conditions water vapor condenses and falls in some form of precipitation. The distribution of rainfall is exceedingly irregular, which results in a variety of vast areas ranging from hot deserts to wet swamplands. In *Science Around You* Tom's place is near a desert while Mary's place is where it rains often.

Wherever rainfall is inadequate, irrigation is essential to farming. If the seasonal distribution of rain and snow produces a dry growing season, irrigation is needed.

In some of the western states irrigated regions get their water from rivers that rise in the snow-covered or rain-swept mountains. Some of these rivers are the Columbia, Missouri, Colorado, and Sacramento, and their tributaries. Water is sometimes stored in a reservoir, or lake, for future use. Canals carry the water from the reservoir to the area to be irrigated. Smaller ditches, or laterals, carry the water to the

fields. When water is needed in a field, gates in the laterals are opened and the water runs into furrows between the rows of crops or trees.

Ways of Working with Children

Pages 4–5 · In the Summer

There are many flowers in the summer.
Plants grow in many places.

Interpreting the Outdoors · As the children look at the illustration on pages 4 and 5 they will probably say that it is summertime. Is it summer now where you live? Do you have some flowers around you like the ones shown? You might wish the children to see how many kinds of plants grow in water, near the pool, in the sunshine along the fence, or in the field.

Observing Many Kinds of Plants · Could you take a walk to a flower garden at the home of one of the children, to a park, or to a meadow? The edges of school grounds are often interesting. You might visit a weed patch with the children. Help them to see the kinds of places where the plants are growing. As the children discuss the many kinds of plants they are learning more and more about the variety among them, and that plants grow in different kinds of places and under different conditions.

Try to observe the behavior of your children to see what attitudes and values they reveal as well as the facts they are learning. Do individuals show a genuine interest in the outdoors? Do their interpretations of living things contain misconceptions? If so, do they show a willingness to listen to and to consider new information?

Plants are usually green in the summer.
There are leaves on the trees in summer.

Learning How to State Hypotheses · Do your children notice the leaves on the trees in the illustration? Do they discuss how green everything looks? These questions might lead to another walk outdoors.

Do your children discuss the time that they expect the leaves to change color and finally drop? Such a discussion helps children to think objectively. Encourage your children to offer explanations. When children state in one season what they expect to happen in another, they may state hypotheses. Sometimes it is wise to discuss or anticipate changes in other seasons. In this way you may help the children to know more fully the seasons through the year. In addition, you may wish to make return trips to the same spots to watch the changes that really take place through the year. In this way you help children to check the hypotheses they made earlier.

These are plants and animals found in Mary's place in the summer as shown on pages 4 and 5 of *Science Around You*. What plants and animals do you see around you in the summer?

Children should not be expected to identify plants and animals in illustrations. The following information is given here for you. You may find it helpful in answering children's questions about the plants and animals at Mary's place. Numbers in the sketch correspond to the following:

Near the Water

1. Jack-in-the-pulpit
2. Candytuft
3. Fern
4. Moss pink
5. Iris
6. Water hyacinth
7. Arrowhead
8. Water cress
9. Water lily
10. Frog
11. Flicker

In the Meadow

12. Dwarf marigold
13. Petunia
14. Larkspur
15. Red clover
16. Daisy
17. Milkweed
18. Monarch butterfly
19. Sheep and lamb
20. Horse and colt

There are many animals about in the summer.

Stating Questions and Problems · What animals do your children notice in the illustration? Do they see any of these animals around them in the summer? What other animals can they tell about that are around in the summer? Begin to develop discussion by using such questions as: What animals are around in the summer? How do they get water? Where do they get water? Use the children's comments or questions whenever possible instead of the ones suggested here.

Observing Animals Outdoors · Could you take a walk near your school or in a park to see a few animals that are around in the summer? There are advantages in taking short but frequent trips with young children. During such trips observe their behavior. Do they notice the many ways in which the animals move and the different mouths, ears, noses, or coverings of various kinds of animals? Does their behavior reveal a healthy curiosity or fear? Too often children's curiosity is changed to fear by observing fearful behavior among other children or adults.

Reading About Summer · You may wish to use the preceding suggested approach before reading page 5. Then point out the title, "In the Summer." Introduce Mary to the children. You might ask: What is summer like where Mary lives? How does it look outdoors in summer? Reading is usually guided by a question, preferably one of the children's.

As your children observe their surroundings they will need help in organizing what they learn. A chart about the animals they see around them in summer may be helpful. The chart might be illustrated with the children's own interpretations of one animal, how it moves, where it might be found, or what it eats.

The following chart suggests one way to help children organize and record their observations:

Animals in the Summer

In the Woods	In a Park	On Water	In a Yard	On a Farm
chipmunk	flicker	ducks	squirrel	skunk
rabbit	sparrows	frog	blue jay	bats

Pages 6–7 · Water for Plants

Plants need water to grow.

Interpreting Conditions for Plant Growth · You will note that these two pages focus on some of the conditions necessary for plant growth.

For example, plants need water. After reading the title with the children, use the illustrations at the top of page 6 to help them establish their own purposes for reading. Help the children to understand that some kinds of plants are called annuals; that these plants have to be replanted each year; and that Mary has just watered the plants. Contrast the dry and the moist soil.

Some plants need much water.

Checking Facts by Observing and by Reading · In the illustration at the bottom of page 6 note that some plants are in the water (water lilies), and that others grow near the water or partly in soil (water cress). If possible, go outdoors to look at the variety of plants growing and to see how much water they seem to need.

Sometimes it may not be possible to go outdoors for an instructional excursion. Then encourage discussion about past experiences.

You may wish to make two lists of plants after your trip outdoors. One list might include plants that need much water; the other, plants that need less water. Try to use the new words *much* and *less* in conversation. If the children can have this concrete experience and use the new words in their conversation first, the reading will be easier. Should a difference of opinion occur about what was seen, check the facts by looking outdoors again. This is a way to help the children think more objectively. See page 6 of this Manual on objective thinking.

Now the children might read to check their observations with page 6 of the textbook. They should, however, read in response to questions, such as: What do plants need? Where do plants grow? The trip outdoors might come after reading page 6. Then direct the children's observations by asking the question: Where do you see plants around you? You will, of course, always use the children's questions or comments when possible to guide their reading.

In some places it rains often.

Interpreting Sky Conditions · On page 7 note the dramatic sky conditions in the first illustration. Explain that the dark cloud is called a rain cloud. If possible, take time to go outdoors to look at the sky. If this is not possible, observe through the windows of your classroom or halls. Let the children tell about the sky conditions they see. Ask them to consider: Is your place similar to the place where Mary lives? How is it different? Does it rain often where you live? Is there little rain?

Use the new words on page 7, *often* and *roots*, if possible during your discussions. Guide the reading with questions, such as: Does it rain often where Mary lives? What does the rain do to the ground? Use other questions if you prefer. Discuss how much rain you have where you live. Do plants and animals there get enough water from rain?

Do your children see at the bottom of page 7 that plants grow above and below the ground? Discuss the wet appearance of the soil. Bring out that this water goes into the roots. It is essential that children see the roots as part of the whole plant.

In answering the question on page 7 the children may discuss what happens to plants during a drought.

Firsthand experiences about living things gained while outdoors are interpreted through painting and discussion.

Painting Summer Scenes · After the children have had several discussions, observed summer conditions outdoors, and read the textbook, they may be able to express their own ideas through painting. Cold-water paints and paper 16″ × 24″ might be used. What they paint should be a matter of their own choice and as they see it. They will reveal their own interpretations. However, they may reveal some misconceptions. Then you might suggest that they take another look, if possible.

Pages 8–9 · Dry, Hot Summers

In some places there is little rain in the summer.
Farmers run water into the fields.
Water from ditches helps the plants to grow.

Discussing Dry, Hot Places · Introduce Tom to the children. The place where he lives might be contrasted with a region such as Mary's or their own. Mention the fact that Tom lives far away from Mary.

Note the desert plants, the horned toad, and the jack rabbit. Tom lives in a place where there is very little rain. It is hot and dry. It is a desert.

Use the children's questions or ask such questions as: How do you think the plants in Tom's garden get water? Where do you think plants have enough water? Do the children notice the small ditches where there is water between rows of plants, and that the plants growing near the water are green?

Using a Globe · To show how far away Tom lives from Mary, you might put a small dot of plasticine or clay on a globe to mark a place in Arizona for Tom's place and another dot for Mary's place. (A plain 16-inch table-stand globe with an axis is recommended.) Mary's place could be anywhere in the north temperate region where there is adequate rainfall for plant growth in summer. Help your children to locate the place where they live on the globe. Do they live near or far away from a hot, dry desert? Do they seem curious about a desert? Are they curious about faraway places? What evidence do you have that they are interested in places different from their own?

You have no doubt used *hot* and *very* in your conversation about the illustration. This helps children to know the meaning of new words before trying to read the printed words. Such a practice should be followed in using new words on each page of *Science Around You.*

Reading to Verify · After much discussion and use of illustrations, your children may say that it must be hot where Tom lives. Now they might read pages 8 and 9 to find out for sure. The reading might be guided by the children's questions, such as: What kind of place is it where Tom lives? Does it rain often? What do the plants in the garden need in order to grow? There may be differences of opinion among the children. Then they might reread the facts in order to be sure and to clear up misconceptions.

Pages 10–11 · Water from Far Away

Plants must have water to grow.
The water comes from far away.

Discussing Places with Little Rain · You might wish to help the children note the appearance of desert plants in the picture. Are they different from plants around you? How much water do the plants need? Encourage children to tell about any time during the summer when there was little or no rain. What happened to lawns, gardens, and flowers? How did the air feel? How high did the temperature on the thermometer go? Point out that it is dry like this nearly all the time where Tom lives and that dry, hot places without rain are called deserts. Use a globe to point out the desert areas in Arizona, northern Mexico,

or other desert regions. From the picture on pages 10 and 11 see if the children question whether there is little or much rain where Tom lives.

Reading for Facts · Differences in opinions make a good purpose for reading to find out for sure. Do your children notice and discuss the fact that plants are growing where there is water; that the plants are green; and that there is water in the ditches? Guide the reading with questions from the children or your own questions. You may wish to ask: How does Tom help the plants to get water? Where does the water come from?

Think of reading as discussion and reading. Give the children time to respond to all the questions. In general, this practice should be followed throughout the use of *Science Around You.*

Stating Conclusions · Help the children to trace the source of water in the garden through the big ditch to the snow-capped mountains in the background. Bring out that the snow melts and runs down the mountains into streams and rivers. With such a development you can help the children to conclude that the water comes from far away, and that it comes from the snow far away.

Let the children freely discuss the question on page 11, "How does water get to plants near you?" You might ask also: Does it rain often in the summer? Do people water lawns and gardens often? Is the place where you live dry like a desert?

Discovering by Experimenting · If possible, secure small cactus plants. Do your children notice the color, sticky spines, and toughness of the plants? Help your children to discover by experimenting how often cactus plants need water. How much water is needed? How often do the children need to water their cactus plants? Do these plants need water to grow? Vary the amount of water and the amount of time between watering the plants. What changes do the children see?

Experiments with Plants and Water

Do cactus plants need much water?

Date	Kind of Plant	Amount of Water	What happens to the plant?

You may wish to compose short group paragraphs about your experiments. At other times it is helpful for children to use a large outline chart to organize and record what they are learning. They can fill in details or changes as they observe them.

Materials Needed

For experiences and experiments suggested in the Manual:

- aquarium
- cactus plants
- clay or plasticine
- dish for indoor garden
- flowerpots, 2
- globe with axis
- Lima-bean seeds
- paints, cold-water
- paper, 16″ × 24″
- pebbles
- rocks for rock garden
- stopper for 1 flowerpot

Further Experiences

Some children may need more firsthand experiences before they are able to reach conclusions. Other children with special interests may have further experiences which they share with the whole group. In this case, these children should be helped to develop some skill in showing an experiment to others so that it can be understood. The following experiences, or others of your choosing, will help you to go beyond those suggested in *Science Around You.*

Watching Water Get to Roots · Use an old aquarium for this experiment. Place a layer of pebbles on the bottom of the aquarium to provide drainage and then fill it about two-thirds full of rich soil. Use two porous flowerpots, inserting a stopper into the drainage hole of one. Sink the two flowerpots into the soil in opposite parts of the aquarium. Place some Lima-bean seeds between the soil and the sides of the glass aquarium as well as throughout it. Fill the flowerpot that has the stopper in it with water and keep it filled thoughout the experiment. Leave the other flowerpot empty.

Through experimentation children have an opportunity to check their predictions or hypotheses.

Warren McSpadden

Encourage children to make predictions (hypotheses) about what may happen. What do they anticipate? Record their hypotheses. Check these hypotheses with what they later observe. They may be able to observe that the roots go down and the stems go up above the soil. After about three weeks remove both pots. Note which pot had the most roots near it. Guide the children in stating their conclusions, such as plants get water through their roots, and plants need water to grow. Help the children to record this experiment.

Observing How Plants Change · Encourage the children to observe how plants grow and change through the seasons. You may wish to make a small rock garden. Is there a spot on your school grounds on a slight incline or slope where erosion is taking place? Is it in a sunny or shady place? Choose appropriate plants for whichever kind of spot it is.

Look at the picture of the small rock garden in Mary's yard on page 4 of *Science Around You.* Help your children to see how plants and rocks will help to hold the soil. Help them to select appropriate rocks for their rock garden. They will need rocks that have a wide base. About half of each rock should go into the soil, making a good pocket for the roots of plants. Such plants as sedum make good ground cover and help to hold water in the soil.

Should you not have space outdoors for gardening, you may wish to make indoor dish gardens. Watch to determine the amount of light and water that your particular plants seem to need. Keep a record of your observations.

View the film *Wonders in the Desert.* The children can see some of the plants and animals used in illustrations in *Science Around You.* (See page 30 in this Manual.)

Evaluation

There are many ways in which to evaluate the progress of children in science. Your science experiences offer rich opportunities for child study. What evidence did you see of increasing interest in changes around you? Did your children grasp the importance of water to living things? Are they more aware of the great variety of plants around them? Were they interested in faraway places, such as a desert? Wider interests will reveal their feeling for the large pattern or idea of space. Did you observe a willingness to check opinions and conclusions by observing again if necessary, to experiment, and to read? If so, the children are using some elements of the scientific method discussed on page 6. What other clues did you get in spontaneous comments?

The following activity should put into use facts presented in this chapter. Plan a series of large pictures (about 18″ × 24″) or a mural

(about 15′ × 4′), using cold-water paints, to summarize the important experiences which the children have had. Their discussions and paintings might reveal some important science meanings, such as: there are many kinds of plants growing in the summer; in some places it rains often; plants need water to grow; or there are many animals around in the summer. This picture record might be kept and compared with records of the children's experiences through the other seasons of autumn, winter, and spring.

In case there has been a drought during the summer, these conditions might be revealed in the painting. Children living in or near a desertlike place would, of course, show plants, animals, and sources of water found around them.

You might wish to have your children tell another group about their experiences. They might explain experiments, murals, charts, and pictures. Then you may notice their grasp of the science meanings you have been developing and clarify misconceptions.

How well do your children use the new science words from this chapter, such as *summer, roots, hot,* and *ditches*? What are their concepts of these words? You might wish to make a picture dictionary of new science words. Organize each page to show the word, its meaning in a sentence, and a picture to illustrate the meaning of the word.

Bibliography

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher,* New Edition. Ginn and Company, 1958.

For the Children

Adelson, Leone. *All Ready for Summer.* David McKay Company, Inc., 1956. Describes changes occurring outdoors from winter through spring and summer.

Blough, Glenn O. *Wait for the Sunshine.* Whittlesey House, 1954. This story about changes through the seasons may be read to children.

Epstein, Sam and Beryl. *All About the Desert.* Random House, Inc., 1957. Excerpts may be used about some of the great deserts, plant and animal life, and the effect of weather and climate on such places.

Goudey, Alice E. *The Good Rain.* E. P. Dutton & Co., Inc., 1950. A good story to read aloud. It tells about the coming of rain and what it means to the city and to the country.

Huntington, Harriet E. *Let's Go to the Desert.* Doubleday & Company, Inc., 1949. Excerpts about some plants and animals found on the desert may be read aloud. The photographs are useful.

Podendorf, Illa. *True Book of Weeds and Wild Flowers.* Childrens Press, Inc., 1955. Some children will be able to read about wild plants and weeds in the fields, woods, gardens, and roadsides.

Webber, Irma E. *Up Above and Down Below.* William R. Scott, Inc., 1943. Simple factual information about the parts of plants above and below the ground. There is variety in stems and roots.

PLANT GROWTH. (EBF) 1 reel, b/w. Shows plant growth from sprouting of seed to the seed dispersal of a plant.

PLANTING OUR GARDEN. (EBF) 1 reel, color. Depicts the activities of planting a vegetable garden. Shows seed germination and development as well as conditions necessary for the growth of seeds.

SUMMER ON THE FARM. (EBF) 1 reel, color. Shows the growth of plants and animals, as well as changes in recreation and work, as the seasons pass.

WONDERS IN THE DESERT. (C-W) 1 reel, color. Jimmy and Joan walk over a desert trail and learn about living things. They see a jack rabbit, a burro with its young, a horned lizard, a pocket mouse, and a desert tortoise.

Filmstrips

IN THE SUMMER. (YAF) color.

SUMMER ON THE FARM. (SVE) color.

II

Autumn

In some places children experience many changes in the autumn. They feel cooler air and dress accordingly. There is less time for outdoor play before dark. Nights are longer. A child may get up before there is much daylight.

Children see changes made by living things. Change in the color of the leaves is one. Children tend to pick colored leaves from trees or the ground. They like to jump into great piles of leaves. They see that leaves wrinkle and break up. You can assist children in gaining the larger concept that decaying leaves help to enrich the soil.

Children see and feel the covers of many seeds. They tell of seeds sailing through the air or floating on water. You can help them to see that seeds are moved about in many ways; that too many seeds do not grow well in one place; and that they may grow far from the parent plant.

Children tend to collect and bring indoors butterfly chrysalises, moth cocoons, and other insects as well as plants. This kind of behavior needs guidance. The chapter about "Autumn" will help your children gain a better concept of the wise use of the out-of-doors. You can help them to accept more responsibility for their environment.

In the chapter on "Autumn" children will give their attention to normal seasonal changes found in the north temperate region where Mary lives. These changes occur in much of the United States, in the southern part of Canada, and to some extent in parts of Mexico. By reading about these changes, children who live in places where there are different conditions will have an opportunity to make comparisons with conditions in their own areas.

Science Meanings for Children

The large ideas or patterns of change, adaptation, and interrelationships are developed through the following science meanings:

The leaves of some plants change their colors in the autumn.
Parts of plants should not be pulled off unless necessary.
There are leaf buds on many trees in the autumn.

Seeds are moved about in many ways.
Seeds may grow far away from the parent plant.
Some animals make changes in the autumn.
Leaves help to make good soil.

Information for the Teacher

Changes Made by Plants in the Autumn · Change and variety are revealed in the many kinds of climate, in the range of temperature, in the length of the growing season, in the amount of rainfall, and in the variation of rainfall within a season. These factors combine in various ways to make many kinds of environments for living things.

As the seasons change you see the adaptations of living things in the parks, woods, fields, meadows, and yards. Some of the most obvious adaptations of plants in the autumn are the changes in color and the falling of leaves. These changes are adaptations made by plants in order to survive unfavorable conditions.

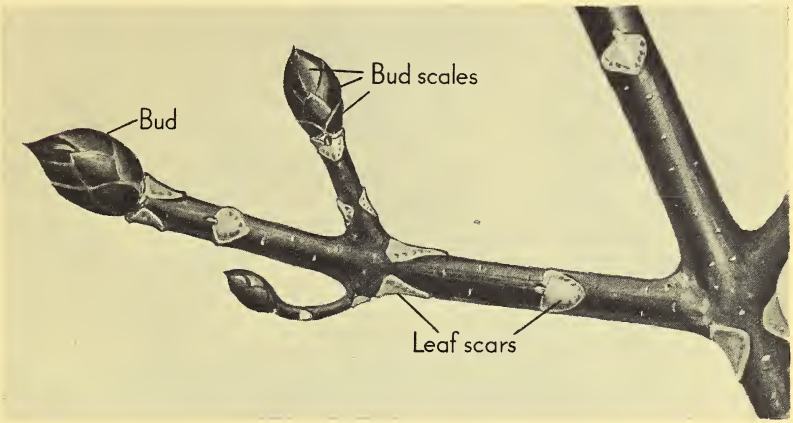
Some plants, such as maples, oaks, poplars, and many other kinds of trees, lose their leaves annually. The changes in plants which cause their leaves to drop help them to survive during the winter.

Before the leaves fall in the autumn, a separation layer is formed at the base of the stem of each leaf. This layer prevents water and food from entering the leaf. When the layer is fully formed, there is nothing to hold the leaf to the tree and a slight breeze will blow it off. Many oaks and some other trees do form this separation layer imperfectly or not at all, and the leaves are retained on the trees for a large part of the winter. The dead leaves fall off when the buds begin to grow in the spring.

Young leaves in the spring show yellow or red pigments before the chlorophyll becomes active. In the autumn the leaves of a deciduous tree often turn red, yellow, orange, or brown before the separation layer is completely formed. In these instances the food-making processes have stopped. The chlorophyll, or green-coloring matter, is not active. Then the other color pigments, which have been present all summer but could not be seen because of the chlorophyll, become apparent. These same changes may take place in the summer if there is insufficient moisture. The fall of leaves is an adaptation to meet drought conditions.

Trees and shrubs develop buds during the growing season until about the middle of July. Then the buds remain dormant until the following spring. Within the buds are a little stem and rudimentary leaves. These buds are covered with overlapping layers of scales in cold and arid climates. Some buds contain only flower structures and still others contain both the leaf and flower structures.

Buds are an adaptation that makes possible rapid growth during the part of the year when conditions are most favorable. They contain the leaf, stem, and flower parts for the next year's growth. They survive the cold weather and are adapted for rapid growth when adequate warmth, sunlight, and moisture become available. Then the tiny structures within the buds grow and grow. They become the plant's new leaves, stems, or flowers.



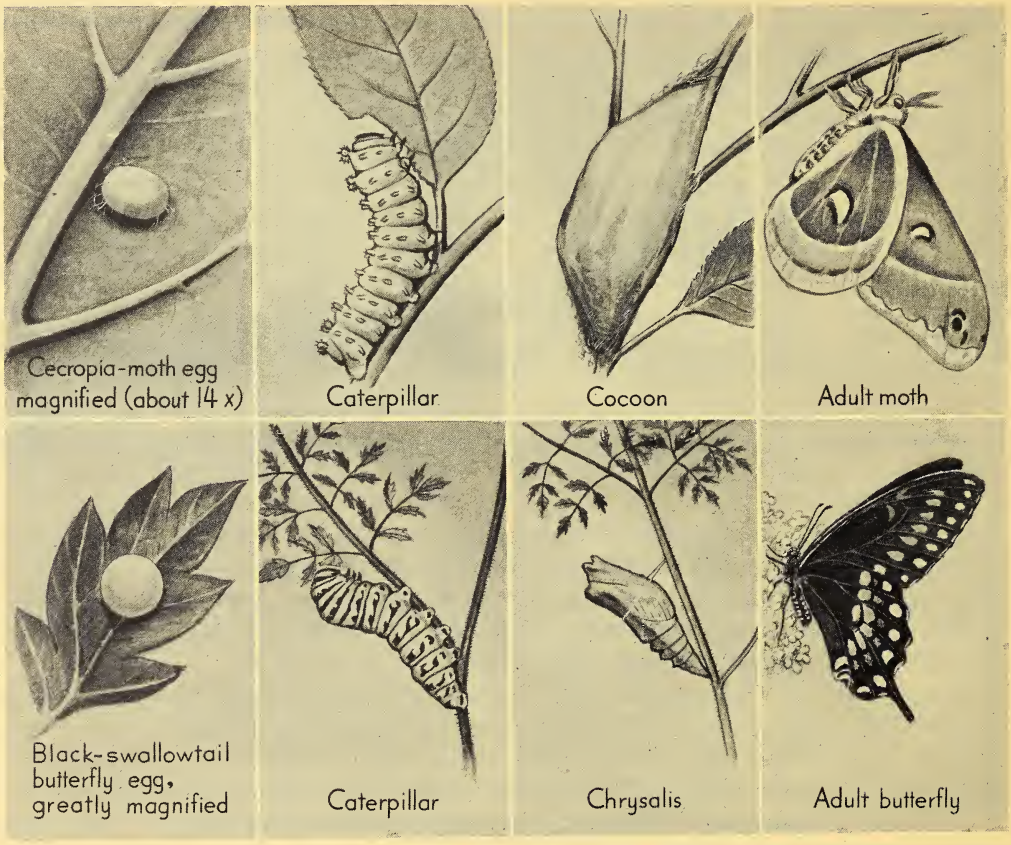
Buds are adapted for rapid growth when conditions are most favorable.

Annual plants are not adapted to meet the conditions of cold winter. Therefore they do not survive. In these plants production of seed is the only means of survival year after year. A new plant grows from a seed. The food in the seed is used by the young plant until its green leaves are able to make food.

The seeds of many plants get moved by wind, water, or animals. Some seeds fall to the ground far away from the parent plant. Thus they have a better chance of surviving since they are not competing with the parent plant for space to grow in, for light, water, and the raw materials of the soil. A great many seeds could not grow well under or near the parent plant. There would not be enough of the necessary conditions for life in one place for so many seeds.

Changes Made by Animals in the Autumn · Animals are dependent upon certain conditions. They do best when it is not too cold or too hot, too wet or too dry. Animals everywhere are more or less well adapted to the environments in which they live. In the temperate zones there are great differences in the living conditions, as everyone knows. The animals that naturally live in these regions, that is, were not brought there by man, are more or less well adapted to the great changes of the various

seasons. In order to survive they are adapted to meet changing conditions of temperature, food supply, and sunlight. For example, some birds migrate to other places. Some insects remain in a dormant stage during the cold winter. These adaptations to changing conditions enable many animals to survive and to reproduce more of their kind.



The development of a moth and a butterfly show adaptations to changing conditions.

Some moths and butterflies lay eggs in the early part of the summer. Some lay eggs on the leaves of plants. The eggs are small and differ in shape and color. A few days after the eggs are laid, most of them hatch. Caterpillars come out of the eggs.

Just as each kind of moth or butterfly lays a different kind of egg, so are the caterpillars which hatch from the eggs different. These caterpillars eat a great deal. They eat the green leaves nearby. On page 18 of *Science Around You* you will see a black-swallowtail-butterfly caterpillar on a stem. Caterpillars like this one soon become so large from eating that their skin splits. The skin splits down the middle of their backs and the caterpillars crawl out. A caterpillar eats, grows larger, and sheds its skin four or five times.

Then another change takes place during the autumn. By this time a caterpillar has grown to its full size. It makes a cover around itself. A cover made by a moth caterpillar is called a cocoon. A cover made by a butterfly caterpillar is called a chrysalis. A cocoon is made by a caterpillar spinning a thread around itself. The thread of liquid comes from within the body of a caterpillar and it hardens as soon as the air touches it. On page 19 of *Science Around You* you will see a chrysalis made by a caterpillar. The caterpillar is protected by the chrysalis. Changes take place in the cocoon and chrysalis.

The cycle described in the preceding paragraphs may occur in some kinds of moths and butterflies several times during the warm months. Pupae that are formed in late fall may remain as pupae during winter months and emerge in the spring. Thus these insects become adapted to seasonal changes and may survive cold winter days.

You will need to help the children understand that cocoons and chrysalises belong out of doors, that if children take them indoors, the moths or chrysalises may come out too soon, when it is too cold for them to live outdoors. In the spring, when it is warmer outdoors, the moths and butterflies can survive.

Many kinds of animals, especially birds, migrate. In this way they escape the hardship of cold winters. Scientists are not sure why animals migrate. Some claim that they are affected by such factors as shorter hours of sunlight, lower temperatures, and scarcity of food as the cold winter approaches.

Birds seem to follow various routes, but a given kind of bird follows the same route year after year. Birds nesting regularly in the central part of the Mississippi Valley and eastward usually follow a route to western Florida and Louisiana. Some then make a nonstop flight of more than five hundred miles over the Gulf of Mexico. One of the most dramatic flights is that of a hummingbird. These little birds fly across the Gulf of Mexico each autumn and spring.

Birds such as the thrushes, tanagers, warblers, and vireos fly at night. Some birds migrate either during the day or at night. These are ducks, geese, and other birds which live along the shores of lakes or streams.

Ways of Working with Children

Pages 12–13 · Changes in the Autumn

Some leaves change color in the autumn.

Planning Experiences · Before you begin this unit of experiences examine the entire chapter on "Autumn" in *Science Around You* as well as the entire section about the chapter in this Manual. Note opportunities for you and the children to have related firsthand experiences outdoors.

You might wish to plan with the children a walk to look for autumn changes. After one trip with such a broad purpose, short trips to look for more specific details may have an advantage.

Discussing Autumn Changes · Tell the children these two pages show where Mary goes to school and that the teacher's name is Miss Day. Encourage them to comment freely about the color of the leaves, the milkweed, and the thistle in the illustration. You might ask: What time of year is it now? Is it autumn around us now? How do you know? What changes do we see? Encourage the children to discuss autumn changes shown in the picture, changes they see on the way to and from school, or changes they see from their classroom windows.

You can easily use such new words as *autumn*, *meadow*, and *woods* in the conversation. Help your children to see that this picture shows a

Children need many opportunities to discover changes occurring in their immediate environment.

variety of places (habitats), such as a woods, field, meadow, brook, and thicket of trees. Ask the children to observe whether the places near their homes are similar or different.

Checking Accuracy of Statements · Help your children to make comparisons with their own season. You might plan with your children to look outdoors again to see if their statements about changes in the autumn around them are true. This helps children to check for accuracy and to think more objectively.

Children will try to get the best statement of truth available when they are so guided. You will further this process by using elements of the scientific method. You can do this by encouraging discussion, asking questions, giving reasons, checking statements by observing, experimenting, and reading. You might ask: How can we find out? What are your reasons for your statement? How do we know this is true? How may we check or test the idea?

Guide the reading on page 12 with the children's questions or comments or with a question, such as: Where do you think the children and Miss Day are going? After responses from the children say, "Let's read to be sure." Modify these suggestions as you wish. Some children may be mature enough to grasp the idea that red and yellow colors were in the leaves during the summer but that you could not see them because of the green.

Parts of plants should not be pulled off unless necessary.

Using the Outdoors Wisely · Observe the behavior of the children on the first trip outdoors. Do they tend to pull off leaves or break branches of trees impulsively? This may not be unusual. Help the children to check their action and ideas by reading page 13.

In the illustration note that children are picking up colored leaves from the ground. Discussion of the reason they are doing this can help your children to understand the importance of conserving living things. When leaves are needed for study, it is a good practice to pick them up from the ground instead of taking them off the trees. Plan frequent trips to the same spots to watch the change in color and the falling of leaves. You may wish to compose experience reading charts with the children.

Do your children show that they accept the ideas on page 13 when they go outdoors now? Do they agree or disagree? With such experiences you help children to develop some understanding of the relationships between leaves and trees. Thus, they may accept a greater responsibility for the environment.

Page 14 · Leaf Buds in the Autumn

There are leaf buds in the autumn.
New leaves will grow out of buds next spring.

Stating Proposals or Hypotheses · Encourage the children to talk about flower buds and leaf buds that they have seen. Children who have been unaware that a leaf bud starts to grow long before the leaf itself grows may express doubt. Do they challenge you or each other? Look upon such behavior as an opportunity to help them change a misconception experimentally, rather than merely telling them what is true. For example, guide them in selecting a certain tree to watch until spring. Also help them to express their idea as a proposal or a hypothesis, such as: We shall watch the leaf buds to see if leaves grow from them next spring. Helping the children to say what changes they expect to take place is one way of helping them to state a hypothesis. Thus they learn to think more objectively.

Examining Leaf Buds · The children should certainly look at and feel the hardness of leaf buds. If possible, examine a variety of leaf buds under a large reading glass. You may wish to open a few leaf buds carefully and see the tiny folded leaf within. The children may read page 14 before or after examining leaf buds. Do they agree with the facts on page 14?

Such new science words as *leaf*, *bud*, and *small* should be used during the discussions before reading the text. Children need to have a concept of a word before reading it in print.

Page 15 · Seeds in the Autumn

There are many, many seeds in the autumn.
Parts of plants should not be pulled off unless necessary.

Observing Seeds Outdoors · On page 15 children may know from their own firsthand experiences such common plants as the thistle, the dandelion, or the milkweed. Discuss common plants growing in the fields or the meadows near you. What kinds of seeds can the children see in the autumn? Do they see many differences in sizes, shapes, and colors of seeds? If so, then the children are growing in understanding of the larger pattern of variety.

Take time to go for a walk to a meadow, a yard, a field, or some place where plants are growing in a natural state. You can probably help the children's thinking by guiding their conversation along these lines: there are many, many kinds of seeds in autumn; many will grow into new plants next spring; and seeds belong outdoors. Plan to watch the seeds outdoors. If this is not possible, encourage the children to tell about seeds they see near their homes, in the park, on the school grounds, or in vacant lots.

Reading and Predicting · Use the illustration on page 15 again. You might ask: What do you think the children did with the seeds they found? What would you do with seeds growing outdoors? Read page 15 to see what Bob and Mary do about seeds. Do your children agree or disagree with Bob and Mary about seeds? If they agree, they are probably developing a feeling for the large pattern or idea of the interrelationships of living things.

Changing Attitudes and Values · You may have children like Bob in your group who wish to take living things back to the classroom. Help the children to see that Bob changed his attitude. The test of a changed attitude is in action. You might take another trip after reading page 15. Do the children tend less to pull off parts of plants? Do they feel that parts of plants should not be pulled off unless it is necessary? Do you sense a change in behavior when they tell about family trips outdoors?

Page 16 · Seeds Are Moved About

Many seeds cannot grow well in one place.
Seeds are moved about in many ways.
They may grow far away from the parent plant.

Giving Explanations · The children may think of the dog with burrs stuck in his hair as being funny. Accept what seems like natural humor to the children. Let them enjoy what appears to be humorous to them. You will in time return to the following important concepts which are being developed: many seeds cannot grow well in one place; they may grow far away from the parent plant; they will grow next spring. Encourage the children to give their own explanations as to how seeds are moved about.

During a walk outdoors or through use of the illustration elicit such questions as: What happens to all the seeds we see in the autumn? How do seeds get moved about? Why is this important? These questions or others will serve as useful purposes for reading page 16.

Using Questions · Note the two questions at the bottom of page 16. Help your children to answer these questions from their firsthand experiences.

Page 17 · Experiments with Seeds

Many seeds cannot grow well in one place.

Testing Proposals by Experimenting · After you read the title and note how the seeds are growing, see if the children can state some hypotheses, such as: Mary's crowded seeds will not grow well; Bob's seeds will grow well. What do the children expect will happen? Can they test these hypotheses by planting Lima-bean seeds in a flowerpot

or some other container? Read page 17 to check opinions and for directions for the experiment. Read parts aloud if necessary to check ideas.

Checking Conclusions · What conclusions are reached? Help the children to keep a written record of their observations and conclusions. A chart somewhat like the one below will help the children to organize their observations.

Experiments with Seeds

Date	Many Seeds	Date	Few Seeds
Oct. 1	We planted many seeds in a flowerpot. We watered them. Will they grow well?	Oct. 1	We planted a few seeds in a flowerpot. We watered them. Will they grow well?
Oct. 6		Oct. 6	

Pages 18–19 · Animals Make Changes

Some animals make changes in the autumn.
Some animals get new covers.

Discussing Changes Made by Insects · Use the illustrations on pages 18–19 to see the changes made by the black swallowtail butterfly in the autumn. Let the children tell about their own experiences with insects, such as seeing an egg, a caterpillar, a chrysalis, or a butterfly; watching caterpillars eat; and finding out that they make a cover before winter comes. These changes may be seen as adaptations to conditions.

The authors believe that children like and use such science words as *caterpillar*, *cover*, *chyrsalis*, and *butterfly*. Help your children to form concepts of specific words. Such concepts come through firsthand experiences, discussion, and reading.

Insects should be left outdoors.
Certain conditions are necessary for life.

Throughout the year you may find all stages in the life of a butterfly. Look for them if possible. Should you find a chrysalis in autumn, you might tie a colored cloth on a limb near it so that you may easily locate it again and watch it outdoors. Outdoor conditions are best for it. In the warm indoors the butterfly would come out too soon and would not live. The insect in a chrysalis is in a dormant stage. This is an adaptation which helps it to survive the cold weather conditions.

Acquiring Desirable Attitudes About the Out-of-Doors · You will see again on page 19 the concept of leaving living things outdoors. As meanings accrue from many experiences children may generalize for

themselves. Desirable attitudes come from such thinking. These are bases for action.

Pages 20–21 · Birds in the Autumn

Birds are quiet in late summer and early autumn.
They are molting.

Giving Explanations · Encourage the children to interpret what the birds may be doing. You might ask: What are birds around you doing now? There may be suggestions about the birds not flying much or losing their feathers. Note that the children in the illustration are near a dense growth where birds might be seen. Discuss such questions as: Where do you see birds around you most often? Are they quiet or noisy in the autumn? Why do they stay near the ground (they are molting)? Do you see feathers on the ground? What does this mean? Are the birds losing some old feathers and growing new ones?

Checking Statements by Reading · Use the children's questions or give them a clue to guide their reading by saying: Let's read the first three lines to find out what the birds are doing now. After the reading note the fact that in the illustration the children are picking up bird feathers. Encourage the children's explanations (hypotheses) as to what is happening to the birds' feathers now. Check their ideas by reading the last four sentences to find out if their hypotheses are true.

Perhaps you would like to keep a chart of the new science words. Include from pages 20 and 21 the words *birds, lose, fly, flocks,* and *south.* The children should help to make the chart.

Autumn is moving time for birds.
Birds leave at different times.

Observing Birds Outdoors · Preceding the use of page 21 could you take a walk to see what birds in your community are doing? Or, encourage the children to tell of their observations of birds made before and after school. During late summer and early autumn children often say that birds have already gone away and that they do not see them around. Note in the illustration that the birds are eating in little flocks. Bring out in the discussion the following concepts: while new feathers are growing in, birds do not fly high; as the days grow shorter and cooler, some birds migrate; and some birds may leave next week or later.

Page 22 · Use Old Leaves — Page 23 · What Changes Do You See?

Leaves make a thick carpet.
They break up.

Using Old Leaves · These two pages are intended to give further experiences concerned with changes in the autumn. In the first picture

on page 22 note the brilliant ground cover of leaves. Focus discussion on the action of Mary and her father looking at the leaves under the colored ones. How do your children think the leaves under the colored ones look and feel? See if they can suggest ideas from their own experiences. Read the text to find out what is happening to the leaves. Can you have a firsthand experience like this with your children? Ask them to observe if there are many leaves on the ground now around them, and what color they are. Can they tell whether the ground cover of leaves is different from one season to another?

If you live in a place like Mary's, help the children compare the ground cover in summer with that in autumn. Suggest that they make a picture record of changes that they see.

Leaves help to make good soil.

Such a practice as the one shown in the illustration at the bottom of page 22 should be encouraged. It is a wise conservation practice in which many children both at home and at school can engage. It will help to build the concept of the decaying process if children can see and feel leaves wrinkling, crumbling, turning brown, and breaking up. Then in the spring they will see how these decayed leaves become a part of the soil to enrich it. In this way children may develop a greater understanding of the interrelationships between plants and soil.

Experimenting with Leaves · Are there many leaves on your school grounds? Could you and your children make a compost pile? Use the second illustration on page 22 for suggestions. Watch the leaves in the pit all through the winter. Listen for the words your children use to describe the decaying process of the leaves. Examine the leaves and see how they are breaking up. Could you use these decayed leaves to enrich the soil during the spring planting?

Materials Needed

For experiences and experiments suggested in the Manual:

bulbs	paints, cold-water
colored cloth	reading glasses
dish for bulbs	rocks, small
flowerpots	string
Lima-bean seeds	wrapping paper

Further Experiences

Children have many experiences with the changing seasons. A few were selected for *Science Around You*. Other activities might also be carried out.

Recording Observations · Give some attention to ways in which the changing seasons affect people. You may wish to help the children use their own experiences in planning a large pictorial record. Cold-water paints and large wrapping paper might be used. In such an experience you might have scenes which develop such concepts as: autumn is the harvest season; food is gathered and preserved or stored; fathers and mothers get ready for winter; children play in leaves; and people wear warmer clothing.

Having a Harvest Fair · You might wish to help the children organize a harvest fair. However, if wild seeds, for example, are to be exhibited, every opportunity must be used to help children learn what and how much should be taken from the outdoors. This entire chapter has been focused on leaving living things outdoors when possible. Should there be enough seeds to insure next spring's plant growth, it would be permissible to take a few seeds. Guiding children in choices and decisions is essential. There might be exhibits at the fair of many ways in which mothers or children have preserved foods for winter. Pictures or murals of autumn scenes also might be exhibited.

Observing Leaf Buds Through the Seasons · Watch leaf buds as the seasons change. Your children might tag the limb of a tree with a string or colored cloth so they can be sure they are looking at the same buds in the various seasons. It would be helpful to secure a few good reading glasses so the children may have an enlarged view of the buds.

Discovering Food Stored in Plants · Some new plants grow from bulbs. Since bulbs will be discussed in the chapter on "Spring," you may wish to prepare for the experience and plant some in the autumn. You may wish to use tulip, daffodil, or narcissus bulbs. These concepts should be kept in mind: plants store food for future use; some plants store food in their leaves; other plants store food in bulbs.

An onion is a kind of bulb that might be used for experiments. Feel the thin, dry, dead outer leaves and the inner fleshy leaves where food is stored. Cut the onion open. Note the stem in the middle.

Grow some bulbs without soil. Plant narcissus bulbs in a dish in which small rocks and water have been placed. Note that food for plant growth comes from the bulb.

The children may be moving in the direction of a better understanding of the adaptation of plants to survive by the stored food in their parts.

Evaluation

There are many ways in which to evaluate the work of the children. You may wish to use the experiences on page 23 for this purpose. Days

or even weeks may have passed since you started this work. The questions on page 23 will call attention to later changes outdoors.

Did work suggested by this chapter provide you with opportunities for child study? What did the individual children say and do to show that they have a better understanding of why living things make changes during autumn? Do the children show more interest in the great variety of seeds around them than in just the identification of plants and seeds? Do they understand a little better that growth of seeds is one way plants have for surviving?

As you work with children you may wish sometimes to evaluate their use of such new science words as *autumn, leaf buds, chrysalis,* and others. What is their concept of these words?

Did you see any evidence of changing attitudes? Are children willing to observe changes in plants and animals outdoors? Are they willing to leave living things outdoors where they belong? If so, they show that they are accepting more responsibility for use of their environment. This may also mean that they are developing some feeling of the pattern of interrelationships of living things and their environment.

On your next trip outdoors observe the behavior of the children. Do they refrain from pulling off parts of plants unless necessary? Are they willing to watch cocoons or chrysalises outdoors?

Are the children making progress in stating hypotheses? Are they showing a willingness to check their statements by reading or by observing outdoors again or by experimenting? If they are learning to think along these lines, they are no doubt learning to use some elements of the scientific method and to think more objectively.

Bibliography

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher,* New Edition, pp. 595–610, 611–632. Ginn and Company, 1958.

For the Children

Hylander, Clarence J. *Out of Doors in Autumn.* The Macmillan Company, 1942. Excerpts may be read aloud to show how living things become adapted to seasonal changes.

Podendorf, Illa. *True Book of Insects.* Childrens Press, Inc., 1954. Children may read here about a variety of insects, where they live, and changes made by them.

Podendorf, Illa. *True Book of Seasons.* Childrens Press, Inc., 1955. Here is material to be read by children that explains why some parts of the earth have changing seasons, and how living things become adapted.

Schlein, Miriam. *Go with the Sun.* William R. Scott, Inc., 1952. Peter realizes that people have their ways of living through the winter and that animals have theirs, too.

Selsam, Millicent. *Play with Seeds.* William Morrow and Company, Inc., 1957. Provides experiences with seeds for children, as well as certain information which may be read to children.

Tresselt, Alvin R. *Autumn Harvest.* Lothrop, Lee & Shepard Company, Inc., 1951. This book reveals changes made by people and living things in the autumn.

Webber, Irma E. *Travelers All.* William R. Scott, Inc., 1944. A simple introduction to plants and their seeds and the ways in which seeds are moved about.

Films

AUTUMN IS AN ADVENTURE. (Cor) 1 reel, color and b/w. The adventures of two children embracing a variety of autumn changes and activities.

AUTUMN ON THE FARM. (EBF) 1 reel, color. Two farm children observe the changes that take place in plant and animal life as well as changes in recreation and work during the autumn.

LAND OF REAL BELIEVE. (Birad) 1 reel, color and b/w. Spring, summer, autumn, and winter unfold in a beautiful and intriguing manner.

SEED DISPERSAL. (EBF) 1 reel, b/w. Shows ways by which seeds get scattered, such as by wind, animals, and propulsion from seed cases.

Filmstrips

AUTUMN IN THE COUNTRY. (CurrF) color.

IN THE AUTUMN. (YAF) color.

III

Air, Water, Weather

The seven-year-old has been reacting to air, water, and weather since infancy. From birth he responded to conditions necessary to his life, including warmth, water, and air. His realization of his environment began with the sensations of his skin as he reacted to wetness and dryness, and warmth and cold.

From the time he could walk the seven-year-old has liked to paddle about in water, to feel the force of water on his hand, to pour out water, to run into a small spray of water, and to play with inflated water wings. He made significant progress in becoming oriented to his environment with each additional birthday.

Experiences with air, water, and weather are everyday occurrences to children. They feel the wind pushing against them. They see airplanes flying in the air above them. Some children have traveled high above the ground. They shoot their paper airplanes through the air. Their pin wheels twirl in the air.

Children learn early that the weather influences what they may do. They hear weather predictions by radio and see them on television. They hear old sayings about predicting weather, too. They may have watched little figures pop in and out of some container supposedly to predict weather changes. Sometimes they are inclined to believe that this is magic or a trick. While children's explanations should be respected, you should help children learn to question magic as an explanation of events.

Children are curious about rainbows and the shapes and colors of clouds. They may become fearful of streaks of lightning and the loud noise of thunder. Your explanations may help to dispel such fears. Curiosity and imagination color children's explanations of such phenomena. But these qualities are present in making explanations and hypotheses, whether they come from a child or a scientist. You can help children begin to verify their imaginative ideas by asking such questions as: How much of what you have said do you know to be true? How can we show that what you have said is true?

Science Meanings for Children

The following science meanings will help you to guide the children's thinking and to focus on the larger patterns or ideas of science, such as change, energy, and interrelationships:

Air is around you.
Clouds are in the air.
Dust is in the air.
Smoke is in the air.
Someday cities may be cleaner.
Water goes into the air.
Water comes out of the air.
Water comes from the air when it snows.
There are many uses for the thermometer.
A weather record shows changes in the air.
Heat makes ice melt. Water freezes.

Information for the Teacher

Air Around Us · Air is all around us and fills every space that is not occupied by something else. Our earth is completely surrounded by air. Many everyday events and situations are explained in a large part by an understanding of the atmosphere. Some of these are ventilation, climate, weather, evaporation, condensation, rust, decay, living organisms, fire, aviation, respiration and other life processes, air pressure, and photosynthesis. Each of these situations is greatly affected by the surrounding air. Each situation points toward the larger patterns of interrelationships and change.

The air is a mixture of several substances which behave in different ways. The air around us is composed of about 21 per cent oxygen, 0.03 per cent carbon dioxide, 78 per cent nitrogen, and 0.94 per cent argon. It contains also small amounts of helium, neon, and other rare gases. In addition, there are water vapor and dust in the air.

Dust and Smoke in the Air · Wind blows over plowed fields or other places where plants are not growing. Dust gets into the air. Other solid dust particles come from tiny pieces of volcanic materials, meteors, smoke, yeast cells, pollen, spores of plants, bacteria, and salt from the sea.

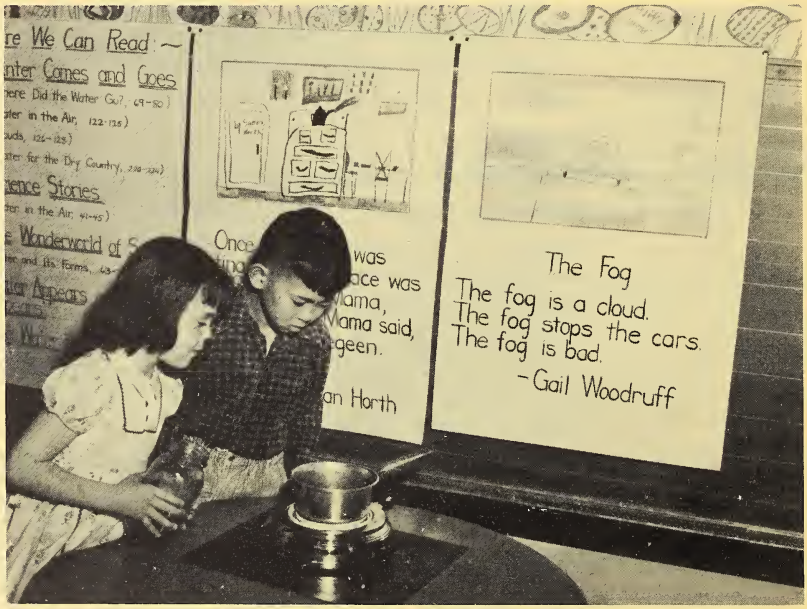
Smoke is made of tiny particles of carbon. Forest fires in Canada and the United States may cause the air to be smoky over wide regions. Smoke from large factories and other sources make difficult problems in living conditions. People are constantly trying to cope with dirt from burning coal, oil, and other materials.

Although there are many disadvantages of smoke and dust, there are

some advantages. Dust helps to make brilliant sunsets. Raindrops condense about dust. In fact, some scientists believe that without dust there would be little or no rain.

Water in the Air · There are varying amounts of water in gaseous form in the air. Moisture is continuously evaporating into the air. Water vapor is invisible. It is an invisible gas.

Water in the air is constantly moving and changing. Water, like other substances, is composed of minute particles called molecules. They move fast and escape into the air from liquid surfaces or wet objects. These water molecules pass between the various kinds of molecules that make up the air. This "flying off" of the water molecules is evaporation and is the means by which water gets into the air.



Children can discover that water in the air is constantly moving and changing, that water goes into the air, and that it comes out of the air.

By heating water you get water vapor or steam. By cooling water vapor you get liquid water. The change of water vapor to liquid water is condensation. Warm air holds more moisture than cold air, and the warmer the air is, the more moisture it can hold. Air loses some of its moisture when it is cooled sufficiently. The air can hold only a certain amount of moisture at a given temperature.

When moist air is cooled to a point where it cannot hold all its moisture, that is, below its saturation point, condensation occurs. Condensed water vapor falls to the earth from the atmosphere as rain or snow.

Fog and Clouds · Water vapor condenses into tiny droplets of water when the temperature of the air is lowered. They collect in so great a number as to form fog and clouds. Clouds and fog are composed of tiny drops of condensed water vapor. When the droplets collect near the surface of the earth, there is fog. Location makes the difference between fog and a cloud. Fog occurs at the surface of the earth while clouds form above the surface.

U. S. W. B.—William S. Davis (Orient, N. Y.)

Cirro-cumulus

Winston Pote

Cumulus

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Nimbus **Cirrus**

Cirrus clouds are often seen in fair weather. They are high, white, feathery clouds. Cirrus clouds are composed of ice crystals.

Cumulus clouds are the larger, white clouds with a flat base. They are fluffy masses often seen in fair summer weather. Some cumulus clouds accompany thunderstorms.

Sometimes you see low sheetlike clouds that cover the whole sky.

These are stratus clouds. Nimbostratus are the black and dark gray clouds. These low-hanging clouds often bring rain or snow.

You need not feel responsible for teaching the clouds by types. Help the children to see the difference in the appearance of clouds and that the sky changes from time to time.

Weather · The state of the atmospheric conditions at any given time and place is described as weather. Climate refers to the general weather conditions over a larger geographic area. All kinds of weather in a given place help to make up its climate. Weather may change from day to day, whereas climate changes only over a much longer period of time.

Ways of Working with Children

Pages 24–25 · Air Around You

Air is around you.
Clouds are in the air.

Discussing the Air Around You · Use the picture of Tom's garden on page 24 with a new emphasis. Read the label *Air* over the garden, over the mountains, and high above the ground. You might ask: What places in the picture show us where air is? Help the children to check their responses by reading page 24. Encourage them to name places where they think air is found around them.

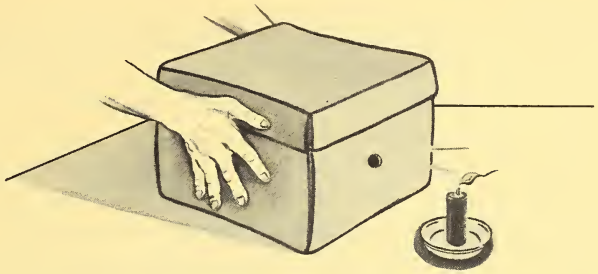
Perhaps you will wish to explore the children's concepts concerning air. Do they think air occupies space, and that air is everywhere? Does their behavior show a willingness to accept or reject these ideas?

On page 25 introduce Betty to the children. Say that she lives far away from Tom. Ask: Where is there air in Betty's city? Use the illustration to discuss air *over* the city, trees, and streets, and air that reaches *high above* the ground and clouds. It is possible that there might be disagreements during the discussion. In science children have a right to challenge and question the teacher, any other adult, or each other. They should be encouraged to ask for reasons. Out of such disagreements you may formulate questions that will guide the children in their reading.

Developing Intelligent Behavior · Do the children question what they have read? Does anyone show signs of disbelief? Does anyone reject guessing or faulty thinking? It is stated that air is all around. How do we know that this is true? How can we test it? Does anyone show a willingness to experiment in order to check ideas? You may wish to encourage this kind of thinking throughout the use of *Science Around You.*

Help the children to try the following experiment to show that air is real, and that it occupies space. Use a large paper box, such as a suit box

or a hatbox. In one end of the box cut a half-inch hole. Squeeze the sides of the box. Do you feel the air coming through the hole? How can you show that this is true? The air coming through the hole in the box will blow paper streamers, feathers, or a candle flame. As a safety precaution the children should not handle matches or a lighted candle.



Here is a way to show that air is real and that it occupies space.

Page 26 · Dust in the Air

Dust is in the air.

Discussing Dust in the Air · You may wish to watch for an opportunity to see dust in a stream of sunlight. Is there much dust around you? Where does it come from? What can you do about the dust? You might ask: What does Betty see in the air? What is Betty doing? Do you ever see dust in a stream of light? Read the first two questions on page 26 and encourage the group to discuss how dust gets into the air around you.

Are the children aware of the sources of dust, such as plowed fields or gardens or other ground surfaces without plants, smoke, pollen, and salt spray from the sea? Discuss the need to dust at school and at home.

In using the second illustration on page 26 introduce Bill. Guide the discussion with questions, such as: Is the air moving fast or slowly? How can you tell? Why is there dust all around? Encourage the children to tell about their experiences with dust in the air.

While looking at the last picture on page 26, you might discuss the following: grass is growing in this place; the wind is blowing, but no dust is blowing; grass holds the soil in place; and grass helps to keep the air clean. After the discussion the children might read the last paragraph to check their ideas. Watch to see if they seem to grasp the relationship between the wind blowing dust and ways to obtain cleaner air. If so, then they may be moving in the direction of a better understanding of the pattern of interrelationships.

Using Facts Learned · Could you look for uncovered spots on the ground around you? Do you see spots covered with grass around you?

Does the grass help to hold the soil? Could you help the children to experiment with a small uncovered spot of ground by planting grass? Could you make a picture record using cold-water paints of the spot before and after caring for it?

Page 27 · Smoke in the Air

Smoke is in the air.
Someday cities may be cleaner.

Observing Smoke in the Air · Encourage children to look at chimneys in their community on their way to school. Do they tell of seeing much or little smoke coming from the chimneys? Is there a smoke problem where you live?

As the children look at the first illustration help them to become aware of the smoke problems in many of our cities and towns.

You may wish to explain to your children that much smoke and soot around chimneys may indicate that the coal is not burning well, and that not all the heat possible is being obtained from the coal.

Check the children's observations by reading to answer questions, such as: Where does the smoke go? What does the smoke do to a city? What must people do to have clean air? When shall we have clean cities? Reread parts of the page to clarify ideas further if necessary. Do the children begin to grasp some of the interrelationships between controlling smoke and dust in the air and having cleaner, healthier places in which to live?

Pages 28–29 · Water Goes into the Air

Water goes into the air.
Water evaporates.

Stating a Problem and Hypothesis · As the children look at the picture on page 28 explain that Bob had poured a little water into the glass a few days ago. He has just discovered that the water is gone. Help the children to speculate about what happened to the water. What explanations do they offer? Suggest that Bob thinks someone poured the water out. After the children have read page 28, you might ask: What happened to the water in the glass? What do you think about Bob's suggestions to do the experiment again?

Experimenting Again to Check · Your children can do this experiment to be sure about what really did happen to the water. Some children have a tendency to blame others for having done something when they cannot explain a scientific phenomenon. Here we are dealing with Bob's attitude and explanation that someone poured the water out of the glass. This selection shows Bob's willingness to try the experiment again, to observe and make a new hypothesis. Encourage your children to check their conclusions too by repeating an experiment.

Rejecting Guessing and Faulty Thinking · Guide the reading of the first two lines on page 29. Ask: What do you think happened to the water? On page 29 the conversation shows Mary's misconception and inaccurate hypothesis, "Maybe the glass leaks." Do your children agree or disagree with Mary? Bob makes a sound hypothesis, "Did it (the water) go into the air?"

Here are illustrations of helping children to use elements of the scientific method in their thinking to build concepts about evaporation. When children state hypotheses and test them by experimenting they use elements of the scientific method.

Reading and Making Conclusions · Discuss the air around the glass in the picture near the top of page 29. Develop the following conclusions through discussion: there is air above, below, and all around the glass; you cannot see the air, but it can hold water; the air around Bob's glass contains water; and the water from the glass evaporates into the air. Ask the children to check their opinions by reading the last two paragraphs on page 29.

Help the children to answer the last question on page 29 from their own experiences. There are situations occurring in everyday life that may be used to give explanations. Some of these are: wet clothing dries; water in paint jars evaporates; and some water in aquarium jars and water in a pet's container go into the air. This is the way to help children see common facts and to generalize from accumulated experiences. You are helping them to feel something about the patterns of interrelationships and change when they discover the meaning of evaporation.

Pages 30–31 · Water Comes out of the Air

There is water in the air.
You cannot see it.
Water comes out of the air.

Giving Explanations and Interpretations · You may wish to introduce this experiment after you work with the concept that water goes into the air. It may follow children's questions, such as: What makes rain? What makes snow? Or it may follow an observation or question about how water gets on the outside of a container on a warm day or in a warm room. Do your children wish to solve other related problems?

Notice the sequence in the illustrations on page 30. Betty is putting ice into the pitcher and there is no water on the outside. In the second illustration there is water on the outside of the pitcher. What explanations do the children offer for the change? Encourage and accept their explanations (hypotheses). Help them to state hypotheses. Do they think the water comes from the inside because the pitcher leaks? Try the experiment to check their hypotheses. If your children express dis-

belief, are they willing to experiment using colored water to find out for themselves?

Checking Explanations by Reading · Help the children to grow in their use of reading as a way to check their explanations and thinking. To guide their reading use the children's comments, or the question in the second paragraph on page 30, or other questions, such as: Where did the water on the pitcher come from? Do you think the air around the pitcher is warm? What did the cold pitcher do to the warm air around it? When did the water come out of the air? How do you know water comes out of the air?

When air is cooled, some of the water comes out of the air.

On page 31 help the children to see what is in the jar. Ask them to note the water on the glass top. How do they think it got there? Guide their interpretation and reading with questions, such as: Where does water in the jar come from? What does air do in the jar? What happens to the air near the top of the jar? What comes out of the air? How is the water in the jar used over and over again?

Note the Christmas fern, wintergreen with red berries, a maple-tree seedling, moss, grass, decayed wood, and soil. It is not necessary for the children to identify any of the plants. Could your children have the experience of making a terrarium? Encourage them to choose common, plentiful plants for it. They should not remove from the out-of-doors plants that are scarce. Use your terrarium to observe that water comes out of the air.

Making Conclusions · Betty states a conclusion based upon experiences and the facts in the second paragraph. Do your children agree or disagree? Your children may state conclusions in a slightly different way. Watch for and listen to their conclusions.

Page 32 · Clouds in the Air

Some clouds are high in the air.
Some clouds are low in the air.

Seeing Many Kinds of Clouds · Help the children to see the sequence in the changing clouds on pages 32 and 33. Observe your sky conditions before reading page 32. Look at the clouds from your classroom windows if you cannot go outdoors. Are the clouds high in the air? If so, what color are they? Or, are they low in the air? If so, what color are they? What words do the children use to describe the clouds? Read page 32 for more information about clouds. You may wish to compose with the children an experience reading chart about their observations

of clouds. Do the children grasp the idea that clouds are different in size, shape, and color, and that they are constantly changing?

Perhaps you could provide opportunities for children to express their ideas with paints or colored chalk, as shown below. It may take several days, of course, to see a variety of clouds.

Children express their interpretations by making group and individual pictures.

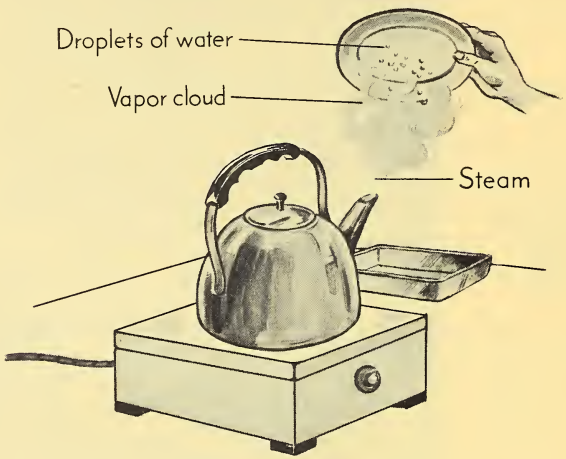
Page 33 · Rain from the Air

Sometimes there is much water in the air.
Sometimes there is more water than the air can hold.

Interpreting Changes in Clouds · You may wish to refer to the experiments and illustrations on pages 30 and 31 again. Use the illustrations on pages 32 and 33 in a sequence to show the changing clouds. Your children can easily see on page 33 that the clouds have now changed; that now it is raining; that the patrol boys are dressed for rainy weather; and that everything is wet.

In your children's discussions of the illustration listen for clues that may serve as purposes to guide the reading. You may wish to use such questions as: When does water come out of the air? When do we have rain?

Testing Facts by Experimenting · You may wish to demonstrate to your children how droplets of water appear on a cold plate when it is held over the vapor from a steaming teakettle. Children should be cautioned that steam is very hot, that they must not try to touch it, that it forms between the water and the vapor, and that it is invisible. Explain that rain comes out of the air in much the same way. The invisible water in warm air is pushed up. When it cools water comes out of the



air and forms visible clouds. Drops of water may form in the clouds and fall as rain.

Do the children seem aware of the relationship between the movement of warm and cold air and the changes in the air that cause water to come out of it? If so, their thinking is moving in the direction of the larger patterns of change and interrelationships.

Page 34 · Snow from the Air

Water comes from the air when it snows.
It comes from water that you cannot see.

Interpreting Facts About Snow · You may be using this chapter where it never snows. If so, encourage the children who have seen snow to tell about their experiences with it, including how cold the air was. If you live in a place where it does snow, you might wish to use this page when snow is falling or is on the ground. Use the illustration as you discuss such facts as: the falling snow comes from the air; there is water in air that you cannot see; it is there all the time; and this water freezes into snow.

Note in the illustration how the children are catching snowflakes on black paper. Try this if you live where there is snow. Use a reading glass to help the children discover that a snowflake has six sides; that the tiny parts are unlike; and that all corners are alike. Can they catch a single snowflake to examine, rather than the larger ones which may be several combined? Snowflakes are often composed of a mass of crystals. Therefore, it is hard to distinguish any one of them. Care should be taken that children are dressed properly for outdoor study.

Avoiding Gullibility by Reading · Children should be guided to make new observations, to repeat experiments or observations, to consider new facts by reading, and to challenge conclusions. By nature children often act impulsively and talk freely. They need guidance in order to consider new ideas and to avoid being gullible or making statements without facts or information.

The following questions, the children's, or your own will help to guide the reading of page 34: When is there water in the air? How do you see water in the air? Can you always see water in the air? When does water sometimes freeze into snow?

Page 35 · Warm Air and Cold Air

There are many uses for a thermometer

Interpreting Weather Conditions · Help the children to interpret the illustration. Bring out the use of an outdoor thermometer, the signs of cold weather, and the chart to show the relationship of clothing to temperature. Note that the teacher is helping Bob read the thermometer.

Use an outdoor thermometer with clear markings if possible. You may wish to secure an outdoor-indoor thermometer. Encourage children to tell about thermometers they have seen or used. You may wish to help your children learn how to read a thermometer so that they may know better how to choose appropriate clothing for changing weather. Thermometers should be large enough for markings to be seen easily and should be placed at the eye level of the children. Read about thermometers on page 35.

Page 36 · Watch the Weather About You — Page 37 · Make a Weather Record

A weather record shows changes in the air.

These pages might be used at any time during the school year. The weather records illustrated on page 36 are intended as suggestions only. Other symbols for recording changes in the weather might be devised by your group. The last three paragraphs on page 36 give children clues for observation and discussion.

Recording Changes in Weather · The chart of the weather record on page 37 may be modified. It may be wise to have the children observe and record weather conditions for a short time and then stop. You might wish to return to this experience as dramatic changes occur during different seasons of the year.

Page 38 · Ice and Snow Melt

Heat makes ice melt.
Water freezes.

Discussing Changes in Water · Note in the first illustration that the sun is shining; the air is probably warmer because the snowman is melting; and some snow has changed to water. Explain that heat makes ice and snow melt. Read page 38 to check ideas after the discussion.

In the second illustration help the children to note that the form of water has changed again. Try the experiment shown and help the children to describe this process of substances changing from one form to another.

Page 39 · What Is in the Air?

Reviewing Ideas · The experiments and other experiences on this page make use of the facts developed in this chapter.

1. As the children watch and discuss the formation of water droplets on the top of the jar do they understand adequately that the water comes out of the air?
2. Do the children show a willingness to test the idea of evaporation by experimenting? Can they vary factors in the experiment and state their conclusions?
3. Can the children give other evidence of evaporation of water into the air?
4. What do the children see in the air around them? Do they show some sensitivity to the amount of dust and smoke in the air?

Materials Needed

For experiences and experiments suggested in *Science Around You:*

- aquarium
- baking dish, shallow, oblong
- bottle
- bowl
- glass cover for aquarium
- glass for water
- ice
- paper, black
- pitcher
- plants for terrarium
- thermometer
- tin cup

For experiences and experiments suggested in this Manual:

- baking dishes, small, deep, and flat
- bottles, 2
- candle
- containers of various shapes and sizes
- cork stopper
- electric hot plate
- feather
- ice cubes
- jar, large
- paints, cold-water
- paper box
- paper streamers
- plate
- reading glass
- straw for drinking
- teakettle
- tea strainer
- tin cup
- tumbler

Further Experiences

These experiences may be used by children who need more first-hand experiences for reaching sound conclusions about air, water, and weather. Some children with special interests or abilities might have further experiences and record their experiments and observations.

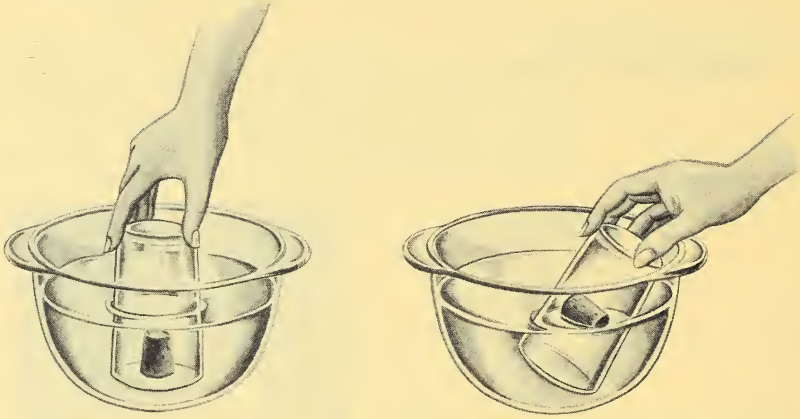
Warren McSpadden

Seeing How Fog Is Formed · Fill a large jar with hot water. Empty all except about one inch of the water. Place a tea strainer over the mouth of the jar. Fill it with ice cubes. Can your children predict where the fog will begin to form? Can they give explanations as to why the fog formed?

Fog forms as the warm moist air comes in contact with the ice. Fog is composed of tiny droplets of condensed water vapor. It forms at the top of the jar first but gradually fills it. Explain to the children that one kind of fog often occurs in much the same way. For example, there may be fog when moist warm air blows over the cold surface of our earth.

Sometimes fog forms near the surface of the earth when the ground cools off but the air over it remains warm. Fog forms as the air is cooled by contact with the ground. You can watch a similar happening by dropping ice into the bottom of the jar in the above experiment.

Finding How Air Occupies Space · Float a cork stopper on water in a deep baking dish. Invert a tumbler over the cork and push the tumbler down into the water. The tumbler does not fill with water. The cork stays on the level of the water. Tip the tumbler a little. The air comes out and the tumbler fills with water.



Showing That There Is Water in the Air · *a*. Place equal amounts of water in several dishes of different shapes. Observe for several days. More water disappears from some containers than from others because of the different amounts of exposed surface.

b. Place equal amounts of water in two bottles. Put a stopper in one. Water does not escape from the bottle with the stopper.

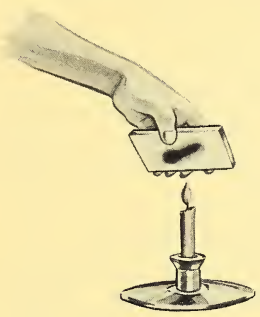
c. Put equal amounts of water in containers of the same size. Put one in a warm place, such as on or near the radiator. Place the second one in a cool, shady place. Evaporation will take place faster from the dish in the warm place.

These experiments will illustrate to children one principle of the scientific method. One factor was changed in each experiment. The variable factors used in the tests were: (*a*) amount of water surface exposed to the air; (*b*) some exposure of water to the air *vs* no exposure; and (*c*) the temperature of the surrounding air.

Discovering How Water Comes Out of the Air · Fill a shiny tin cup with colored ice water. Tiny drops of water soon appear on the outside of the cup. Do the children think the tin cup leaks? Where do they think

this water comes from? Children can see that the water outside the cup is not colored. The water on the outside of the cup comes out of the air. When the air next to the cup cooled, the water in the air condensed on the cup.

Seeing When Fire Produces Less Smoke · For safety purposes, the teacher should perform this experiment while the children watch. Light a candle and pass a flat piece of glass about three inches square or a small, flat baking dish through the upper part of the flame. Ask the children to note whether the black on the glass looks like smoke. Now place a straw near the flame and blow through it as you repeat the experiment.



Little or no black forms on the glass. Fire produces less smoke when there is enough air to fan the flame.

Explaining Dust in the Air · There is usually dust when there is no rain. Encourage the children to think about the dust in the air by asking: Is the ground dry around you because there has been no rain? Does the wind blow dust into the air? Does your mother dust often? Where does the dust come from? Tell about dust storms where there is little rainfall.

Evaluation

Do you have some evidence that your children have improved their ideas of such basic patterns as change or interrelationships? Do the children accept the fact that air is all around them? Can they explain how water comes out of the air and goes into the air? Are they more aware of the clouds changing in the sky? Do they have an increasing

interest in air, water, and weather? Did you observe in the spontaneous behavior of the children their willingness to consider new ideas and to reject magic or superstition as explanations of events?

What concepts have the children developed of such words as *dust, smoke, dirty, weather, evaporate, high, low, cloud, melt, freeze,* and *thermometer*?

Did the children have an opportunity to use the following elements of the scientific method: sensing and stating problems; giving explanations (hypotheses); improving their way of stating a hypothesis; checking an experiment by doing it again; checking facts by observing and reading; and reaching and stating conclusions?

Bibliography

For the Teacher

Blough, Glenn O., and Huggett, Albert J. *Elementary-School Science and How to Teach It*, pp. 179–208. The Dryden Press, 1951.

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 392–459. Ginn and Company, 1958.

For the Children

Bendick, Jeanne. *All Around You.* Whittlesey House, 1951. Selections may be read to children about air, wind, fog, rain, snow, ice, and water.

Blough, Glenn O. *Not Only for Ducks.* Whittlesey House, 1954. Mike learns something about the importance of rain to living things in the city and country.

Freeman, Mae and Ira. *Your Wonderful World of Science.* Random House, Inc., 1957. Excerpts may be read to children about water, air, clouds, heat and cold, and weather.

Larrick, Nancy. *See for Yourself.* E. P. Dutton & Co., Inc., 1952. Useful experiments and factual materials about air and water to be used with children.

Schloat, Warren G., Jr. *The Magic of Water.* Charles Scribner's Sons, 1955. Andy finds out about water by observing and experimenting.

Schneider, Herman and Nina. *Let's Find Out.* E. M. Hale and Company, 1956. Useful experiments about air, water, and weather.

Scott, William R. *This Is the Water That Jack Drank.* William R. Scott, Inc., 1950. Jack learns about the water that is all around him.

Films

AIR ALL AROUND US. (YAF) 1 reel, b/w. Gives explanations and experiments showing the properties of air, air pressure, and the expansion and contraction of air.

ONE RAINY DAY. (Cor) 1 reel, color and b/w. Peggy watches a storm approaching during dry weather. She sees changes in wind and clouds. After the storm she sees a rainbow.

WHAT MAKES RAIN? (YAF) 1 reel, b/w. Explains the concepts of evaporation and condensation as they apply to the water cycle.

Filmstrips

WEATHER. (YAF) color.

WHAT MAKES RAIN? (YAF) b/w.

IV

Our Earth

Spatial concepts of the seven-year-old started in babyhood when he focused one eye on a fixed point. He could explore space a little further when he learned to co-ordinate his eyes. He increased his spatial sense. Then he learned to creep and walk from one room to another. Gradually language assisted him as he learned the meaning of such words as *on* and *in*, *above* and *under*, *high* and *low*, and *up* and *down*. At the age of three he knew where he was going, although he might have been fearful of his own shadow. By the time he was five or six, he could make a simple map of a road leading to some nearby place.

When the child is about seven he has some awareness of the earth's surface around him, and of the moon, sun, and clouds. However, he still may have fears of high or unfamiliar places, of darkness or shadows, and other things. He may not feel sure about his own shadow. He is aware of other shadows but often cannot interpret them adequately to his own satisfaction.

Concepts of the seven-year-olds about the earth are expanding from home to faraway places. Many have had fathers or other members of the family or friends go to faraway places. World events have made this true. Airplane flights around the world are common news. Faraway places now seem relatively near because of radio and television. Many children of this age have never known a world without television.

The seven-year-old is ready to follow a teacher's guidance. He may learn more about sunshine and shadows, darkness, and unfamiliar places. He may learn enough to dispel his fears. He may think with great imagination about our earth. He may accept with confidence what he reads as being the best information available to him at the time.

Children of today are interested in space travel. They like to imagine a planet that is different from theirs. Perhaps this interest can be utilized to develop realistic ideas of the largeness of our earth.

Science Meanings for Children

The following science meanings will help you to guide the growth and development of children's understanding of the large patterns or ideas of space, time, and interrelationships:

The earth is large in comparison with a familiar neighborhood.
The earth is like a big ball.
There are many farms and cities on the earth.
The ground and ocean are part of the earth.
The air and clouds belong to the earth.
Our earth is round. It is like a very big ball.
The earth is a big moving ball. It is moving all the time.
The sun is shining somewhere at night.
Shadows are made when sunlight does not pass through objects.

Information for the Teacher

You will want to help your children develop their concepts of space early, rather than allow them to hold on to misconceptions. Their conceptions of space and their knowledge of the largeness of our earth will continue to grow after childhood.

Our Large Round Earth · Although the earth is large, it is small when compared with many other objects in the universe. The earth's diameter is about 8000 miles. While the earth seems like a great ball, it is not a perfect sphere. It is flattened at the poles. The diameter of the earth at the equator is twenty-six miles greater than its diameter from pole to pole.

Gravity is the force that holds the atmosphere near the earth. People, buildings, plants, and animals are held to the surface of the earth by gravity.

The earth is made up of three parts. These are the gaseous, liquid, and solid parts. The atmosphere is the gaseous part of the earth. The atmosphere is continuously wearing down the land and helping to move soil about. The solid part of our earth is composed of rocks and soil of various depths. Rocks have been pushed up from great depths. Oceans, rivers, lakes, ponds, water within the earth, and water in the atmosphere make up the liquid part of the earth. The oceans cover about three fourths of the earth's surface. However, the liquid part does not exceed the solid part in volume since the greatest depth of the ocean is only about six and a half miles.

Changes on Our Earth · There are great changes taking place on the earth all the time. The earth's surfaces rise and wear away through long

periods of time. Climates of the earth have changed in the past and may be changing now. Living things on the earth have made great changes and adjustments. Others have not and have become extinct. Those living today have been more or less successful in making adaptations to changing conditions.

Our Earth Moves · The earth rotates on its axis every twenty-four hours, causing day and night. It rotates from west to east in a counterclockwise movement. People in places east of a given point see the sun rising earlier. People gain an hour every 15 degrees of longitude while traveling westward around the world. People traveling eastward lose an hour every 15 degrees. In other words, there is an hour's difference in time for each 15 degrees of longitude.

The earth revolves about the sun in a counterclockwise movement. The earth takes a year to revolve around the sun. The sun is also moving while the earth is revolving.

We do not feel the earth moving. The objects in space are far away and our earth does not pass them as it moves. All the objects on our earth rotate with us. Our earth moves smoothly, and we cannot notice any movement.

Ways of Working with Children

Pages 40–43 · Our Large Earth

The earth is large in comparison with a familiar neighborhood.

Looking Far Away · The authors suggest that you take the children to a spot such as a hilltop if you are in the country, or to the top of a building if you are in the city. Help the children to see a succession of places or objects; that some are near; that some are far away; and that they are only a tiny part of our large earth. You will want to listen to the spontaneous comments made by the children. Spontaneous behavior may reveal questions, explanations, interpretations, and attitudes.

You might wish to use the illustration on page 40 to discuss the things that Jim can see. Note the order in which he may see them. You might ask: What does Jim see near him? Do the children say that he sees the cows near the river; that beyond the river he sees the hills; that far away he sees other farms; that Jim can see far away; and that the farm is only a tiny part of the earth? Encourage your children to reveal their ideas of space.

Reading New Facts · Guide the reading in such a way that the children may see the objects in the order that Jim viewed them. Continue to discuss what is near; what is far away; and that the earth as a whole

is large in comparison with this one place. Should there be a difference of opinion, the children might reread the pertinent parts of "Our Large Earth."

Painting What You See · Could your children make on-the-spot individual sketches of what they see nearby and far away on the outdoor trip to a hilltop or the top of a building? What children express should be accepted without much critical evaluation. If they should express misconceptions about the shape of trees, the sky and ground, rays of the sun, or other things, perhaps you might help them to look again. Such misconceptions will be cleared up in time.

A neighborhood in a city is only
a tiny part of our large earth.

Estimating Time and Distance · For page 41 you may wish to use the illustration, experiences, and reading in ways similar to those for page 40. Do the children see the street and cars near Betty? Do they see that the lake comes next? Do they see that the trees in the park are beyond the lake, and that part of the city is beyond the park? Do they see the airplane high and far away? It will take many experiences to develop space concepts.

New words should be a part of the speaking vocabulary before children are expected to read them. Encourage your children to express through large pictures what they see nearby and far away. You are building a sensitivity to space around them, and that this place is only a tiny part of the earth.

It may help children to understand distance to discuss how long it takes to walk or to ride to places. Such questions might be discussed as: How long does it take you to walk to school? How many blocks do you walk to school? Or do you ride to school? How long does it take? How far is it to school? Encourage your children to express their ideas freely.

The children might discuss places they have visited. You might ask: How long did it take to get there? This will help to develop time and space relationships. If a child has gone on a fairly long overnight trip, he might explain what took place, such as the number of meals eaten on the train, going to bed, and seeing rivers, mountains, oceans, plains, prairies, and cities. The distance traveled, if known, might be compared with the total distance around the earth.

The earth is like a big ball.
There are many farms and cities on the earth.
There are many people on the earth.

Using a Globe · As you look at the illustrations on pages 42 and 43 explain to the children that these are pictures of our earth. You may

wish to tell your children that these pictures show the earth as it would look to one far away from it. What seems to be their thinking about the size of the earth? It must be remembered that the children's conceptions of space will enlarge as they grow older.

Use a globe, explaining that it is somewhat like a map of our round earth. Locate approximately where the children live on the globe. Point out other places which they have heard about. Put small pieces of plasticine or clay on the globe for Jim's farm and Betty's city and the place where the children live. Note what a tiny part of the whole globe they occupy—that there is space for many, many farms and cities on our earth. There are many people on these farms and in these cities. To help children develop the concept of large numbers of people you might ask: How many children are there in your school? About how many people live in your neighborhood (town or city)?

Raising questions and expressing disagreements and misconceptions should not be discouraged. Rather, they may be used to give a purpose for reading page 42.

Recording Facts · After using the illustration, having discussion, reading, and other experiences, you may wish to help your children compose as a group a story similar to the one on page 42. It might read something like this:

Our Earth

Our town is part of the earth.
The biggest city is a part of the earth.
The farm near us is a tiny part of the earth.
There are many cities and farms on the earth.
Many, many people live on the earth.

The ground and ocean are part of the earth.
The air and clouds belong to the earth.

Expanding Ideas About Space · Find the labels *Air*, *Clouds*, *Ocean*, and *Ground* on the sphere illustrated on page 43. Talk about the ground and ocean being a part of the earth. Have the children seen or traveled on an ocean? Can they tell about the experience? How many days and nights did the trip take?

Talk about the air and clouds belonging to the earth. Has anyone traveled in the air? How many hours was the trip? How long is it by train or car for the same trip? What could they see? Has anyone heard an airplane above the clouds but could not see it?

Help the children to discuss other things around them that belong to the earth, such as rivers, mountains, caves, gullies, plants, and animals.

Pages 44–45 · Our Earth Is Round

Our earth is like a very big ball.

Discussing the Shape of Our Earth · Encourage your children to give their interpretation of the shape of our earth. You might ask: What makes you think that? What are your reasons for what you say? Discuss the land and water areas in the double-spread illustration on pages 44 and 45.

Help the children to find the land and water parts on a globe. Explain that our earth is round and somewhat like the globe. Using a globe, you may wish to ask: Where would you ride in cars or trains? Where would you ride on a ship?

Introduce Betty's trip that has been on the land, on the water, and in the air. Point out on page 45 where Betty used to live. Do the children see the train on which Betty began her trip? Do they see the ship on which she traveled across the ocean to the United States? Note on page 44 the airplane and car in which Betty traveled after she left the ship. Ask such questions as: Would she have to leave our earth? Do you think that these places are far apart? Read pages 44 and 45 to find out for sure. Try not to feel too hurried. Think of reading as reading and discussion.

Warren McSpadden

Children may compare our moving earth with a globe or top. However, our earth never stops turning.

Pages 46–47 · Our Earth Moves

The earth is a big moving ball. It is moving all the time.

Sensing Questions or Problems · Do the children show an inquiring attitude as they interpret the illustration on pages 46 and 47? Do they ask, "Does the earth move? Does it stand still?" In what ways does the picture of the earth, its shadow, and the immense sky contribute to their concepts of space?

As the children read page 46 they may ask again and again: "How do we know the earth is moving? Why don't we feel the earth moving?" The thought that the earth is giving them a ride may be amusing. Encourage them to name anything else that is getting a ride on the earth.

As you discuss the ideas on page 47 see if the children remember passing nearby objects, such as trees, telephone poles, and houses, while riding. We seem to pass more distant objects, as a house, more slowly. But objects out in space are so far away that we cannot pass them. The earth does not pass them.

Some children may grasp such ideas as: the earth moves smoothly; it does not turn sharp corners; it does not slow down for stop lights; it does not run over rough roads; it never starts and stops; it keeps on moving all the time.

Think of children's concepts of space as a kind of behavior. Behavior is revealed in what they say and do. Do they accept the ideas developed on pages 46 and 47?

Page 48 · Night and Day on Our Earth

The sun is shining somewhere at night.

Discussing Night and Day · Use the picture of the earth to show night and day. Have the children point to the day side of the picture first, then point to the night side. Check to see if they have this correct. Ask the children to note the color of the sunshine on Jim's farm on the day side of the picture.

Experimenting to Clarify Ideas · Some children may say, "The sun is not shining at night." You may wish to use a bright light, such as a flashlight, with a globe to show the relationship between the moving, or rotating, earth and the succession of day and night. Do the children accept the fact that the sun is not shining on us at night? Explain that it is shining somewhere at night; it shines on the other side of the earth; there are other people who have day when we have night; some people sleep while we work and some people work while we sleep; but the sun is always shining somewhere.

Guide the reading with questions, as: When does Jim's farm have sunlight? When does it have night? Reread as many sentences as necessary to clarify ideas.

Page 49 · Sunlight and Shadows

Shadows are made when sunlight does not pass through objects.

Experimenting with Sunlight · Use the illustration to determine the materials you will need in this experiment. The illustration shows you how to use these materials. You might ask: What makes the shadow?

Why does the glass not make a shadow? What hypotheses do the children make?

Reading to Check Conclusions · After the children have completed the experiment, they might read page 49 to check it. Help them to formulate some conclusions.

Page 50 · Making Shadows

Sometimes we see shadows.
Something stops the light.

Experimenting with Shadows · The illustration suggests the materials needed for making a shadow play or for guess-who games. These are a large piece of cloth like a sheet and a source of light.

Read the first four sentences on page 50. Encourage the children to discover by experimenting where they should stand and where the light should be. Of course, they will discover that they should stand between the light and the curtain. Their bodies stop the light. Help the children to check their own conclusions by reading the last two sentences on page 50.

Page 51 · Thinking About Our Earth

You may wish to use page 51 to help your children evaluate progress made in using this chapter. This will enable them to re-use in some new situations the facts learned.

Discuss the illustration at the top of page 51. Read and discuss the questions: "What stops the sunlight? What makes the shadows?"

Go outdoors on a sunny day and look for shadows. Do the children observe any differences in the length of shadows or the direction in which they fall at different times of the year? Do not expect the children's concepts to be very clear about shadows outdoors. They will need many experiences, discussions, and explanations.

Materials Needed

For experiences and experiments suggested in *Science Around You:*

- clothespins
- cord
- cotton sheet
- electric light
- glass, flat, smooth, square, such as windowpane

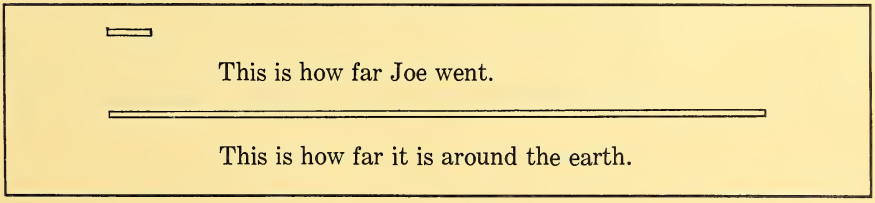
For experiences and experiments suggested in this Manual:

- clay or plasticine
- flashlight
- globe with axis
- paints
- paper for sketches
- paper for shadows
- scissors
- strips of paper

Further Experiences

These experiences may help you to care for individual differences among your children. Some children may need additional experiences before being able to reach sound conclusions. Other children, the faster learning ones, may use these experiences to extend and enlarge their present understanding. These children should be encouraged to give reasons for their statements and, when possible, to share their experimentation and observations with other members of the group.

Showing the Distance Around the Globe · The distance covered by a child while traveling might be measured by placing a strip of paper between two points on a globe. Use another strip of paper to measure the distance around the globe. Put these two strips of paper on a chart. Captions might be used with the correct strips, such as:



Finding Out How the Earth Moves · Explain to the children that their globe represents the earth. Turn the globe on its axis to illustrate the manner in which the earth rotates. You may wish to use a flashlight shining on one place to develop the relationship between the earth moving, or rotating, and the succession of day and night.

You may wish to have a child stand and turn around and around in the way he thinks the earth rotates. Whether you should add a sun child and let the earth child rotate and move around the sun child depends upon the interest and maturity of your children. It is not the purpose of the authors to go into the causes of day and night at this level.

Making Shadows · Shadows are made when sunshine does not pass through objects. A further study of shadows might begin with observing shadows of trees, buildings, people, or other objects. You might wish to have large pieces of paper ready when the children arrive at school. Have a child stand so that his shadow falls on the paper. Trace around the shadow and then cut it out. This shadow will be long. At noontime make another shadow of the same child, and again at the close of day. The papers representing the shadows will be of different lengths. The longest shadow will be made when the sun was lowest in the sky, the shortest when it was highest. The shadow made in the afternoon will fall in the opposite direction from the shadow in the morning.

You may wish to try this experience during different seasons. Do children make predictions and test to see if they are accurate? The low sun of winter makes a long shadow, while the higher sun of late spring makes a shorter shadow. Long shadows may be connected with coolness, while short ones may be related to warmth.

Evaluation

In this chapter you may have helped your children to think more seriously about the vastness of our earth in the universe. Do they seem willing to consider new and reliable information and ideas? Are they growing in their ability to think in terms of space and time?

Do the children understand that things may seem big at times and small at other times, depending upon the object with which they are compared? For example, do they accept the idea that the earth is small when compared with the sun but that it is large when compared with a city? Did you observe any fears, misconceptions, or changing attitudes? Do the children seem to have confidence in what they read in this chapter?

Bibliography

For the Teacher

Carson, Rachel L. *The Sea Around Us.* Oxford University Press, Inc., 1951.

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 232–264. Ginn and Company, 1958.

For the Children

Bendick, Jeanne. *All Around You.* Whittlesey House, 1951. This book contains simple factual material about the sun, our earth, water, and living things.

Exler, Samuel. *Growing and Changing.* Lothrop, Lee & Shepard Company, Inc., 1957. Describes night changing into day, the sun in different positions in the sky, and other changes.

Film

OUR BIG, ROUND WORLD. (Cor) 1 reel, b/w and color. If children are well prepared to see this film, appropriate parts will show them our moving earth, light from the sun, the changing seasons, and how some people will have daylight while others do not.

V

The Sky

Gradually the seven-year-old is becoming more aware of changes in the sky. Since play-pen days he has soaked up hours of sunshine. Everyone knew his reactions when he became too hot and cross. As time passed he wished for sunshine after several rainy days and inquired, "When will the sun shine again?" He learned his reactions. He made interpretations.

Sometime, somewhere, the seven-year-old has heard stories of the man in the moon. If he asked, "Is it true?" someone may have helped him to distinguish between fantasy and truth. About the time he started to school, his life-space expanded. That is, he moved about with greater independence. He walked or rode to school. He knew more people. Common objects had more meaning as he touched, saw, listened to, tasted, or smelled them. Experience increased. He may have been puzzled by seeing the moon in the day sky as he walked to school. Soon he gave his attention to space travel. Through movies, television, or travel he is becoming acquainted with our universe.

You may hear some misconceptions held by the children while using this chapter in *Science Around You*. For example, children often say: "The sun is not shining at night." "The sun is smaller than our earth." "The sun goes around the earth." "It is cloudy. The sun is not shining." Children are familiar with the common saying, "The sun rises and sets."

The authors know that young children cannot grasp a very complex concept of the true size of the earth, sun, and moon. They know that the child looks about him and sees what seems to be a large earth. The sun and stars look small by comparison. They look smaller than nearby trees, houses, and buildings. They look smaller than mountains, farms, and cities.

However, most children are curious and imaginative. They will listen and accept as their own some of the facts that you know and tell them about our universe. They will come to have confidence in information given to them by teachers and parents and reading materials.

Science Meanings for Children

Use this chapter to help the children have confidence in and rely on accurate information. The following science meanings will help you to focus attention on certain concepts of the large patterns of space, energy, change, and interrelationships:

The sun is far away. It shines all the time.
The sun is so hot it gives off light.
The sun looks small but it is very large.
We see the sun in the east in the morning.
We see the sun in the west in the afternoon.
The moon is smaller than the earth or sun.
The moon gives us light.
Sometimes we see a whole round moon.
Sometimes we see the moon in the day sky.
The clouds in the sky change.

Information for the Teacher

Our Sun Is Far Away · Our sun seems small because it is so far away. Our earth is about 93,000,000 miles away from the sun. The sun is approximately 3,000,000 miles nearer the earth on January 1 than on July 1. This is a short distance in comparison with the total distance from the sun. It is, of course, unnecessary to use any of these large numbers with young children.

Our Sun Is Large · The diameter of our earth is about 8000 miles. The diameter of the sun is 109 times that of the earth. Our sun is just an average-sized star. It is average also in color, brightness, age, and size. Some stars are brighter, older, and larger than our sun. Some stars are less bright, not as old, and smaller than our sun. The stars are suns and our sun is a star. Such facts help us to get a better conception of space in the universe.

The sun shines all the time and gives off light and heat in all directions. When the sun shines on us, the other half of the earth is in darkness. When we have night, the sun is shining on another part of the earth. We are in the shadow of the earth at night.

We often say that the sun is not shining on a cloudy day. Actually the sun is shining far out beyond the clouds. The clouds make a shadow over the ground. We are in the shadow made by the clouds. The clouds stop the light.

The Sun Is Hot · Our sun has a temperature at the surface of about 10,000° F. The temperature of the inner part of the sun is much, much hotter. Some stars are hotter than our sun. It is believed that the

temperature inside some stars may be as much as 18,000,000° F. The sun is not just a ball of burning gases with flames. Its immense heat is not due to burning. The causes of the sun's heat are not fully known. As changes take place in the sun a large amount of light, heat, and other forms of energy are given off.

The Earth's Moon · Next to the sun the earth's moon is the most noticeable object in our sky. This moon is the nearest body to the earth. Sometimes it is 222,000 miles from the earth. Sometimes its distance is as much as 253,000 miles from the earth. The diameter of the moon is about 2000 miles.

Moonlight is reflected light from the sun. The moon is not a source of light. It is seen by reflected light. The stars shine by their own light.

The moon seems to rise and set because of the rotation of the earth. The sun and stars seem to do the same. The moon is the only body to move around the earth. It does this in about twenty-seven and a half days, or a little less than a month. It rises and sets about fifty-one minutes later each day as a result of its revolution around the earth.

Stars · Stars are suns. They shine by their own light. There are many stars larger than our sun, and some are smaller. Some stars are hotter than our sun, and others are cooler. A large star may appear small because it is so far away. Stars are all around the earth. They are in the sky during the daytime but we cannot see them because the sun is so bright.

Sometimes stars seem to twinkle and to have fixed points. This, of course, is not true. The movement of the air above us causes the seeming fluctuation in the brightness of a star.

Ways of Working with Children

Page 52 · The Sun Is Far Away

The sun is far away from our earth.

Changing Misconceptions · What comments do your children make while studying the illustration on pages 52 and 53? Does anyone say that the sun or stars are smaller than our earth? Do the children say that they look smaller than nearby trees, houses, mountains, farms, or cities? Such proposals are incorrect, but they have merit if one views the child's learning as growth in interpreting the environment.

Rejecting Guessing · While children must have freedom for discussion, they need help in the process of getting the best statement of truth available. You may help them to reject guessing or faulty thinking with such questions as: How do we know that this is true? What reasons can you give for what you say? How may we be sure? How may we

find out? Perhaps the children will question one another or others if you encourage them to ask for reasons.

Guide the children's interpretation by referring to the illustration again. Note that only a small part of the sun is shown on page 53, how much smaller the earth looks than the sun, and that the sun is far away from the earth. Explain that the sun seems small because it is so far, far away. Could you help the children to formulate a question or two concerning the sun?

Seeking Reliable Facts · Now ask the children to read page 52 to check their ideas about the distance from the earth to the sun and that it is not a part of our earth. Children do not discover new facts, such as the ones in this selection, for society. However, they may discover these new facts for themselves.

Explain to your children that books can help us to answer questions —that they help us to check our guesses and learn the facts about things. Thus you can help children to have confidence in some books as well as in scientists who discover new facts.

Page 53 · The Sun Is Hot

The sun is so hot it gives off light.

Discussion and Reading · Encourage the children to tell of their own experiences with the sun's heat and light, such as getting severe sunburns, seeing plants wilting in a garden, feeling the heat of a desert and the glare from the sun. Bring out facts about the sun in the discussion before reading page 53. You might wish to list some of the children's ideas on the blackboard. Then you might suggest: Let's read page 53 to see if our ideas agree with those in this selection. Later you might ask: What fact did you read that we did not mention? Do the children agree or disagree with the facts stated?

Page 54 · The Morning Sun — Page 55 · The Afternoon Sun

The sun looks small but it is very large.
We see the sun in the east in the morning.

Listening to Explanations · Introduce "The Morning Sun" on page 54 to the children. Explain that the illustration shows Mary's farm. You might ask: Where do you see the sun in the sky early in the morning at your house? Then read to find how it looks to Mary. Do your children agree or disagree with Mary? Note the questions directed to the children in the text. Take time to get their responses. Ask such questions as: Why do you think it is morning here? In which direction is the sun rising? Note that the labels in the illustration read *East* and *West*. Ask:

Where does Mary see the sun? How does the sun look to you? Your children may say what Mary did—that the sun looks smaller than the hill, house, and trees.

Finding Directions · You may wish to explain to a child that when he faces the morning sun, he is facing east and the west is behind him. If he raises his arms horizontally, his left arm will point to the north and his right arm to the south. When he looks at the late afternoon sun, he is facing the west and the east is behind him. If his arms are now raised horizontally, his right arm will point to the north and his left arm to the south. Could your children try this?

We see the sun in the west in the afternoon.

Accepting Explanations · On page 55 have the children note the position of the sun. What explanations do children offer about the position of the sun? What changes do they notice?

Sometimes children may express interpretations as: "The sun comes up," "The sun rises," "The sun goes down," or "The sun sets." These are common expressions we hear often. However, the sun does not "rise" and "set." Nor does the sun move from the east to the west as it appears to do. Actually the earth rotates on its axis. The rotation of the earth from west to east makes the sun appear to rise and set.

Ask questions such as: Where do you see the sun in the sky early in the afternoon? Does it look small or large to you in comparison with buildings and trees? Where do you see the sun later in the afternoon? Note the elements in the illustration on page 55 similar to those on page 54, and the opposite position of the setting sun.

Perhaps you might ask your children: Where does Mary see the sun now? Do you agree or disagree with Mary? Is the sun as small as Mary thinks? Read page 55 and discuss whether the children think the sun is so small. What conclusions do they reach?

Page 56 · The Sun Is Large

The sun looks smaller than the earth but it is much larger.

Interpreting the Size of the Sun · Encourage the children to discuss how much larger the sun is than farms, lakes, cities, the moon, and the earth. Use the illustration to help point out how much larger the sun is than the moon; that this page is not nearly large enough to show the true size of the sun. Suggest that they read to check their ideas with the facts on page 56. Review and reread page 52 telling that the sun is far away. Point out that it looks small because it is so far away.

A child might hold a piece of chalk or a small ball or other objects

close to the children and then gradually move away from them. Measure the distance with a yardstick. Does the chalk look smaller than it did when viewed close up? Does it really become smaller? Try the experience with several other objects. This experience will be more effective if done outdoors where greater variations in distance can be used.

Help your children to reach and state conclusions from their own experiences about the fact that distance affects the appearance of objects. The children might easily get the idea by watching a car approach from far down the street or road, or by watching an airplane flying high in the sky.

Page 57 · The Sun Is Shining All the Time

The sun shines on cloudy days.

Changing Misconceptions · Do your children state any misconceptions about the sun not shining all the time? What reasons do they give for their explanations? Use the picture, helping them to bring out the fact that it is raining and it is cloudy, but the sun is shining above the rain cloud. Note the sun above the clouds. Should there be some disagreement among the children, decide who is right by reading the first paragraph on page 57.

As the children look at the airplane in the illustration ask them to notice whether it is flying above the clouds. Can Mary see the airplane? Now read the second paragraph to find where the airplane is flying. Have the children tell of experiences similar to Mary's.

The illustrations, reading, and their own experiences should help children reach conclusions, such as: the sun is shining on cloudy and sunny days; it shines all the time; and airplanes often fly in the sunshine above the clouds.

Adults, as well as children, frequently say on a rainy day, "The sun is not shining today." Children interpret this literally and thus build up a misconception. Remember that mankind required centuries of study to learn about the universe as we know it today and that still more study is needed to learn about the universe in our world of tomorrow.

Experimenting to Show Reasons · The fact that the sun is shining somewhere all the time may be shown by using a flashlight and a globe. Place a pin in the globe at approximately the place where the children live. Shine the light on the globe and slowly turn the globe in a counterclockwise direction. While one part of the earth is turning into sunlight, another part is turning out of it. One half of the earth is always lighted. Encourage the children to question the accuracy of the sizes and distances used in the demonstration.

Pages 58–59 · The Night Sky

The moon is smaller than the earth or sun.
The moon gives us light.
Sometimes we see a whole moon.

Observing the Moon in the Night Sky · On page 58 this large picture of the moon will no doubt cause the children to talk about the moon as they have observed it in the night sky. Have they seen the moon when it looked like this? Discuss the moon's color, shape, and size. Refer to page 52 if there is doubt about the size of the moon in relation to the sun. Note the concepts of size that your children express.

Will children accept the fact if you tell them that the moon's light is reflected from the sun? It has no light of its own. Show and discuss what *reflect* means. Help the children develop ideas of reflection, such as: reflections of one's self in another person's eyes, of buildings or trees on water, and of various things in a mirror or on a large piece of glass or some other shiny surface.

Encourage the children to tell of nights when they saw a large round moon while playing outdoors, or of seeing moonlight from a bedroom window or shadows at night.

Sometimes we do not see the moon in the night sky.
Sometimes we see the moon in the day sky.

On page 59 contrast the night sky with that on page 58. Do the children notice that there are stars but no moon? Can they tell about nights when there was no moonlight in the night sky?

Have the children seen the moon in the sky as they walked to school? Do they know why it looks less bright in the daytime than at night? Compare the color of the moon in the last illustration on page 59 with its color on page 58.

Pages 60–62 · Clouds in the Sky

Sometimes there are tiny white clouds high in the sky.

Watching Clouds Change · Use these four illustrations to show in a sequence how the clouds in the sky change. On page 60 help the children to see the tiny, fluffy white clouds in the blue sky. Note that it may be a good day for sailing or fishing. You might ask: What kind of weather do we have when we see tiny white clouds? After you read the first sentences, look at your sky. Are your clouds like those described in the second paragraph? Read to find out for sure. The last two questions on page 60 will guide another observation of your sky or will lead to discussion of the illustration on page 61.

Sometimes there are black clouds low in the sky.

Use the illustration on page 61 by asking: What is happening in the

sky now? Note that the setting is the same as for the illustration on page 60. Note the wind in the sails, that the clouds are larger, that some are blacker, that the wind is moving the trees, and that the sailboat seems to be returning to land. Ask: Are the clouds in the sky changing? What makes you think so? Do you think the clouds are moving? What makes the clouds move? What kind of clouds do you see now in the illustration? Read page 61 to verify your ideas.

Rain comes from the big dark clouds.
The clouds in the sky change.

In the illustration at the top of page 62 note that the same setting is used as in the preceding illustrations but that now there are low black clouds and a wind, and that the father and the boy are dressed for rain. Ask: How have the clouds changed? What do you think the weather is like? Read the first paragraph to find out about the kind of clouds shown in the illustration.

In the second illustration on page 62 note the changing sky conditions. Read to find out what happened to the low rain clouds.

Page 63 · Watching the Sky

The clouds in the sky change.

Painting Clouds You See · Do your children show signs of increasing interest in the changing sky? From time to time you may help your children plan a picture record of changes they see in the sky. Their pictures may reveal the facts they really know about changing sky conditions. They might show the sequence of changes in the clouds for several days. The children will find it is easy to make pictures outdoors if they use colored chalk.

Reading Directions · The illustration and text will give you and your children clues for observing changing conditions of your sky. The questions in the second paragraph suggest some things to look for. Could your children add others? Perhaps you will wish to help your children compose appropriate captions for their pictures.

Materials Needed

For experiences and experiments suggested in this Manual:

- ball
- button
- colored chalk
- electric light
- flashlight
- globe, on stand with axis
- metal, e.g., tin, nickel, copper
- paints and paper
- plants in flowerpots, 2
- yardstick

Further Experiences

You will probably find a wide range of individual differences among your children. Some may need further discussion and experiences to grasp some of the science meanings about space as developed in this chapter. Others may use further activities to show their reasons for believing certain facts to be true. Notice the contributions of individual children during the discussions of these experiences.

Showing That the Sun Is Much Larger Than the Earth · Have your children had experience with counting and measuring with a yardstick? If so, a few may show other children this experience. Draw a circle outdoors about one and a half yards in diameter to represent the sun. About thirteen and a half yards away from the sun circle, place a button about half an inch in diameter. This will show a fairly good relationship between the sun and the earth both as to size and distance apart.

Showing That Objects Receive Heat from the Sun · To illustrate that objects receive heat from the sun, place various metal objects (tin, nickel, copper, etc.) in sunlight and in shade. Then find out which feel warm and which feel cool. Those in the sunlight will feel much warmer to touch than those in the shade.

The earth receives little of the sun's total heat. Place a ball in one corner of the room. Place a light, such as an electric light, in the opposite part of the room. Point out how the light gives off heat and light in all directions. Then ask how much of the heat and light is received by the ball.

Experimenting to Show That Plants Need Sunlight · Show that green plants need sunlight by placing one of two similar plants in the sunlight and the other in darkness. Water both plants. The plant in sunlight will grow well, whereas the one in darkness will be stunted.

Experimenting to See How Distance Affects the Appearance of Objects · Show the brightness of light on a piece of paper that is held close to a small light. Compare this with the appearance of the same paper when it is held far away from the light.

Evaluation

Do science experiences give you opportunities for child study? Do you see evidence that the children have enlarged their concepts of the basic patterns of space, energy, change, and interrelationships? If so, do they accept such facts as: the sun looks smaller than the earth but it is larger; the sun shines all the time; and the sky changes?

What concept do your children have of the following words: *larger, smaller, east, west, high, low, cloudy,* and *clouds*?

In what ways did you notice the behavior of the children changing? Do they respect the ideas of one another? Did you note some misconceptions held by the children? What sources and reasons did they offer for their beliefs? In your discussions did you notice some children rejecting guessing and faulty thinking? Did you notice a willingness to read for facts? Were they critical of the selection? Did they seem to accept your explanations and interpretations? Do they challenge any of your statements? Children should feel free to express themselves. They should never be humiliated because of ignorance or mistakes or questions.

Bibliography

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 189–226. Ginn and Company, 1958.

Greenlee, Julian. *Teaching Science to Children*, pp. 37–43. Wm. C. Brown Company, 1951.

For the Children

Johnson, Crockett. *Harold's Trip to the Sky*. Harper & Brothers, 1957. This is a highly imaginative story and should be treated as such if used with children.

Lewellen, John Bryan. *The True Book of Moon, Sun, and Stars*. Childrens Press, Inc., 1954. Shows the relationship of the spinning earth to the moon, the sun, and other stars.

Schneider, Herman and Nina. *You Among the Stars*. William R. Scott, Inc., 1951. Some of the illustrations and a few selections about the sun, moon, and stars may be useful.

Films

SUN, EARTH, AND MOON. (AIF) 1 reel, b/w. Children must be prepared to see this film. Parts of it will, however, contribute to their idea of space, moving bodies, and heat and light from the sun.

THE SUN'S FAMILY. (YAF) 1 reel, b/w. Explains what the solar system is.

THIS IS THE MOON. (YAF) 1 reel, b/w. Explains the relation of the moon to the sun and the earth.

Filmstrip

THE MOON. (YAF) color.

VI

Winter

Many children using *Science Around You* will live in the north temperate region. The chapter on "Winter" tells about the region where Mary lives. Places in this region have many dramatic changes in winter. Children who live in similar places know that then days are shorter and nights are longer. They play in snow. They watch snow machines at work.

Children may know that certain animals are not around at all in winter. Have they wondered what happens to those animals, where they go, and what changes are made by them in order to live through the cold wintry season?

Children may see brown-looking grass in winter and may say that it is dead. Some plants that they see in summer die and have to be replanted each year. Children see evergreens in winter. Do they know how they change, and when they get new leaves? Children who live in cold winter places may go with their parents to warm winter places. There the days are longer. Nights are shorter. Clothing is different. The seasons are different. These children may visit warm winter places like Sandy's in *Science Around You*.

All these everyday observations of the environment offer rich opportunities for further interpretation with children. However, children need teachers who will listen to their explanations, who will challenge their thinking and reasoning, who will help them to obtain more adequate concepts of the changing seasons.

Many children will never have seen snow nor skated on ice. They swim outdoors when children in other regions play in snow. They play outdoors about as long at one time during the year as they do at another time. They know that many people spend their winter vacations at this warm place.

Thus children in many regions may begin to see that the changing seasons bring different conditions in different places. Since there are such wide variations in seasonal changes throughout the United States and Canada, children should begin to understand that the seasons where they live may be unlike those in places somewhere else.

Science Meanings for Children

Wherever children are living, there are changes taking place in living things around them. In whatever region you are using *Science Around You,* you can help the children become more skillful in observing changes in their immediate environment. At present you may help them to enlarge their concepts of changes they see nearby. Later their concepts will enlarge, and they will see the relationships between these changes and living things in their environment.

The following ideas about Mary's place in the north temperate region and Sandy's place in a warmer region will help you to focus your work on the growth and development of the larger patterns or principles of conditions necessary for life, variety, adaptation, and change:

In some places there are many changes during a year. (Mary's place.)
In some places there are few changes during a year. (Sandy's place.)
Some animals stay about all the year. Changes are made by animals.
Some animals hibernate for a part of or all winter.
Some birds travel longer distances than others.
Some plants live all winter. Changes are made by plants.

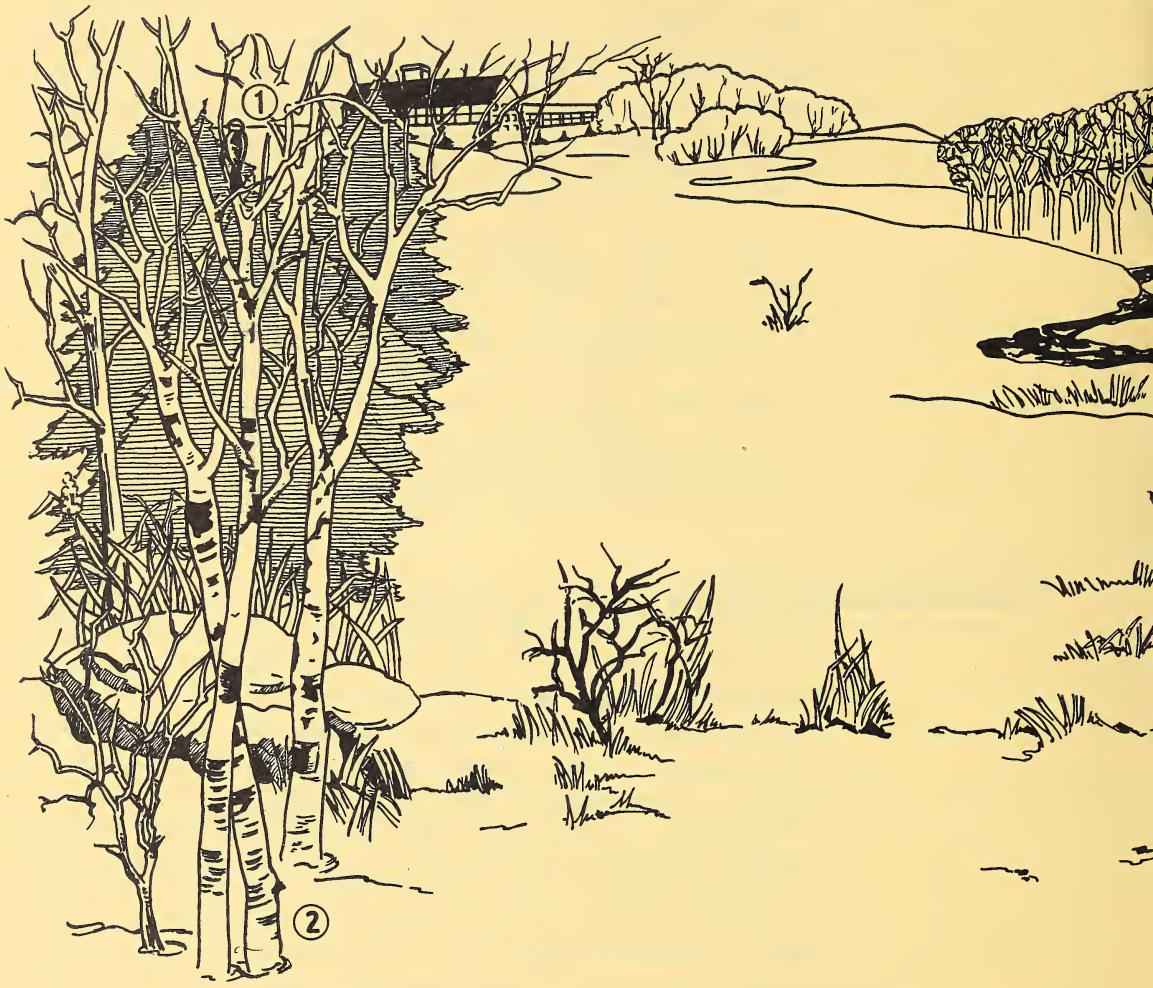
Information for the Teacher

Changes in the Winter · For more information about changes in winter, you might read the section addressed to the teacher in the chapter on "Autumn." It tells of changes made by some plants and by some insects, and of the migration of animals.

Some animals find a protected place to stay on cold wintry days. These animals may have difficulty in finding food during the winter. Skunks, raccoons, and chipmunks may hibernate during cold weather. Then they come out and look for food on warm sunny days. Squirrels, muskrats, and meadow mice also come out on warm days looking for food.

All these animals eat and eat before winter comes and grow very fat. During the winter their energy is supplied by the stored fat within their bodies. Chipmunks and squirrels eat nuts they have stored during the autumn. They eat other food when they can find it. Chipmunks store nuts in one room of their underground homes. These places are well below the frost line of the frozen ground.

Woodchucks, frogs, toads, turtles, and snakes are some of the animals that hibernate all winter. Some frogs and toads go into the mud at the bottom of a pond. Many turtles go into mud or sand at the edge of streams. Some snakes go under rocks, into caves, or decayed logs. Woodchucks dig into the ground below the frost line of the frozen ground. These animals stay underground all winter. They undergo great changes



while hibernating. They do not see, hear, smell, or seem to feel while in this state. Breathing is very slow. Their heartbeat is very feeble. Most of these animals exist in this state all winter. They come out thin and hungry when it is warmer in the spring.

Many animals in the north temperate region show how adaptations to adverse conditions of low temperatures and scarcity of food in their environment are made by hibernating. Hibernation is not fully understood by scientists.

The plants and animals around in the winter at Mary's place are shown on pages 64–65 in *Science Around You.* However, children should not be expected to identify them. The following information may be helpful to you in answering children's questions about plants and animals in the illustration. The numbers on the sketch above correspond to the following:

1. Downy woodpecker
2. Birches
3. Snowshoe rabbit
4. Sparrows
5. Redpolls
6. Juncos
7. Bluejay
8. Evergreens

Ways of Working with Children

Pages 64–65 · Cold Winter Days

Winters are cold in some places.
In some places there are many changes.

Interpreting Winter Conditions · You might wish to make a list of changes the children have noticed around them. To assist them in observing the changes you might ask: Where are the animals that were about in summer and autumn? What animals do you see on page 65? Do you have ice and snow in winter where you live? Do you see evergreens in winter around you? Do you see animals' tracks in snow in the winter?

Help the children to recall that the outdoor area around Mary's school is the same as that shown in the chapter on "Autumn" on pages 12 and 13. You might ask: What season do you think it is now? Is it this cold in winter where we live? What is our winter like? Help the children to note changes that have taken place where Mary lives.

Reading About Cold Winter Days · Guide the first reading of page 65 by using children's questions or comments or by asking such questions as: What are Mary and the other children looking for? Where are they looking for animals?

Encourage and help the children to discuss the last two questions on page 65. Could you have a similar firsthand experience outdoors with your children? Perhaps your children might reveal their interpretations of winter around them by painting a series of outdoor winter scenes. Help them to write appropriate captions for their pictures.

Pages 66–67 · Animals in the Winter

Some animals are about all winter.
These animals find food.
Hair and fur keep them warm.

Discussing Winter Animals · Discuss the animals that are seen in your area in the winter. How do they survive? What food do they find? Where do they stay on cold snowy days? Do their colors change in winter?

Some children using *Science Around You* will be living in places where there is very little or no snow during the year. On the other hand, some children see snow almost all winter. All children can compare the woodland scene in the illustration on page 66 with that they see around them all the time. Wherever you are, you may help children to use the illustration on page 66 by asking: How do you know it is a cold winter day? Do we have cold days like this? Use children's comments and questions to develop the discussion.

Discuss the snow and the protective white coats of fur of the snow-

shoe rabbit and weasel. Explain that these animals are looking for food. Discuss the fact that the hair or fur of these animals is new and thicker in winter; that the animals fluff out their hairs; and that this does not permit the cold air to penetrate so much. Explain that in winter the color of some animals in cold places changes to white or a dull gray or brown which helps to protect them from enemies. Do you see this change around you? Encourage children to give their reasons when offering explanations.

There are several means of adaptation which enable many animals to survive adverse conditions in winter.

Reading to Clarify Ideas · Well-stated questions should guide the reading. Rereading may be done to clarify opinions, to give additional facts, to resolve differences, or to answer questions. Think of reading as reading and discussion. Try not to feel too hurried.

Some animals hibernate on cold days.
They come out on warm sunny days.

Rejecting Guessing · Most children are acquainted with the squirrel and skunk in the illustrations on page 67. Do you see these animals around you all through the winter? On a very cold day, when children are warmly dressed for cold weather, could you take a walk to look for squirrels or other animals? Should you not see animals, help the children to think where they could be. Could some of them fly away? Could a squirrel run far enough away to reach a warmer place? What do animals eat in winter? Try to observe outdoors to find some of these explanations instead of just guessing. Encourage the children to reject guessing.

Stating Hypotheses · If the children are encouraged to think and to state some of their explanations as hypotheses, you have an excellent opportunity to use still another step of the scientific method with them. They need practice and guidance in stating hypotheses. Guidance can be offered through such questions as: What animals stay about because they find food? Do some animals that we do not see for a few cold days sleep and wake up as people do? Encourage the children to verify their ideas by further observations, discussion, or reading.

You know that data can be gathered through observation and experimentation. However, when these methods do not answer problems or questions fully, you can help the children to see a genuine use for authentic reading material. Now you might ask your children to check their proposals or hypotheses by reading page 67. Guide the reading paragraph by paragraph, if necessary. Take time to let children discuss ideas presented. The last paragraph applies the principle of hibernation

to other animals that hibernate only part of the winter. It also helps the children to reach a conclusion about partial hibernators.

Page 68 · Some Animals Hibernate All Winter

Some animals are not around all winter.

Questions and Hypotheses · You may wish to use the same procedures with page 68 as were suggested for page 67. Could you take another walk to look for toads, frogs, and turtles? What does their absence suggest to the children? Do they ask where the animals are that they saw last summer and autumn? Children sometimes question: Could they fly away? Could they run away? Could they crawl to faraway warmer places? Can a frog swim to faraway places? Where do these animals go on cold windy days?

Investigating Hibernation · As the children look at the illustration on page 68 ask: How do you know it is wintertime at this pond? What is the woodchuck doing? Where is his food? What is the frog doing? How has he changed? Are these animals above or below the cold frozen ground? How can you tell? What do the labels tell you? Why are these animals safe?

Perhaps you still have a frog in the classroom for study purposes or could get one now to watch. You might prepare a screened box or a terrarium much like the one on page 31 in *Science Around You.* Make it as much like an outdoor place as possible. Keep the terrarium near a window where it is cool.

After a very cold week end your children may find that the frog seems to have disappeared. You might *carefully* remove the soil from the frog and notice how inactive and somewhat shrunken he is becoming. At first he may seem dead and will not move when you touch him. Continue to observe what your frog does on cold days. What does it do on warmer days? If the children have such experiences you are helping them to understand that hibernation is another means of adaptation.

Use the word *hibernate* in discussion to develop its meaning as used on pages 67 and 68. Other words such as *rest* and *sleep* do not entirely express the full meaning of the word *hibernate.*

Seeking Reliable Information · Encouraging children to observe and investigate helps them develop desirable attitudes toward getting the best information possible. A step in the process of getting accurate information is checking with authentic reading materials. Help your children to check their hypotheses, to get new facts, or to check their conclusions about some animals hibernating all winter by asking them to read page 68.

Page 69 · Birds in Winter

Some birds migrate.
Some travel a long distance.
Animals do not think and plan as people do.

Observing Birds in Winter · Encourage the children to tell about birds around them in winter. Ask them to notice how the birds look on cold winter days. Do their colors look duller than in spring? Do they look fat with their feathers fluffed?

Use the illustration to help children recall birds that stay in your area all winter. Call their attention to the kind of place in which the birds are, such as in bushes with seeds, in wooded areas, and near water. Ask such questions as: Why do birds look fat? How do their feathers look? Do you see sparrows or chickadees? What other birds do you see about you in winter that were not there last summer? Did they come from colder places? Will they return to those places in the spring? Then ask the children to read for additional facts.

Throughout the study of animals and adaptations made to their environment, you must guard against the impression that animals think and plan for the coming winter as people do.

Organizing Learning · You might wish to help children organize a bulletin board of their own pictures or others about animals in winter. They could prepare their own captions.

As your children listen to explanations, discuss firsthand experiences, or read to check facts they will need help in organizing their learning. One way to help organize ideas is to prepare an experience reading chart. Here are sample charts that may be adapted to suit your children.

Our Winter Birds

Here All the Year	Here from the North
sparrows	
chickadees	
juncos	

Our Winter Birds

On January 4 we went to the park.
We saw some sparrows eating seeds.
We saw a chickadee.
He looked funny and fat.
His feathers were all fluffed out to keep him warm.
These birds stay around all year.

Pages 70–71 · Some Plants Live Through the Winter

The roots of grass live through the winter.
There are four seasons in many places.

Observing Plants in Winter · Discuss changes you see made by plants. Do some plants above the ground look dead? Are the roots alive? What plants around you live through the winter?

Help your children use the four illustrations in sequence to see the changes that take place in each season of the year. See if they remember that the setting of these pictures is the same as for Mary's garden shown on page 4. For example, ask: What changes do you see? What plants have lived from autumn into winter? What plants died in the winter? Did all the grass die? What is the color of some of the grass in winter? Which part of the grass died? Which part of the grass may have lived through the winter? Perhaps your children could make a series of pictures to show plants through the seasons.

Reading and Predicting · Then you might guide children in their reading of page 70 to find out for sure about the grass that lived during the winter. Encourage them to predict changes that will come in the spring. For example, what do they think will happen to the grass? While talking about one season, it is easy to talk about changes expected in other seasons. Use the illustrations to help the children anticipate and predict changes in the spring and summer. Then read page 71.

Help the children to summarize their ideas, such as that some plants live through the winter; that in some places there are four seasons; that the seasons recur in regular order; that one season makes a unit of time; that several units of time, or all seasons, make a year.

Take time to discuss the questions addressed to the children at the bottom of page 71.

Pages 72–73 · Trees Make Changes

Trees live through the winter.

Observing Changes · Do your children remember the changes made by trees from observing and reading about autumn? If you tagged a tree in the autumn to observe through different seasons, you might go out now to look at leaf buds. Find out whether they are small and hard.

Open a leaf bud to see if you can see tiny leaves which will grow out in the spring. Observe the leaf buds through a reading glass if possible. Help children to understand that they should remove only enough leaf buds for their study purposes. Take only a few leaf buds from one place. Plan to observe the living things in the same places during winter and spring. Discuss the fact that plants do not think and plan for coming winter as people do.

Some plants stay green all the time.
Some plants keep their leaves through the winter.

Ask the children to observe whether there are pine trees near their home or school. Do they know what trees keep their leaves and stay green all through the year? Could they look for a variety of evergreens?

Evergreens are not growing or active during the winter. They do not lose their needles or leaves at any particular time. They lose only a few at a time. However, during the spring you will notice a new green growth at the ends of some branches.

Page 74 · Warm Winter Places

In some places it is warm nearly all the year.
Plants grow and have flowers.

Finding Out About Warm Places · As the children look at the illustrations on pages 74 and 75 ask if they know what kind of a winter place this is. Do they live in a place like this? Have they visited a warm winter place like this? Introduce Sandy, who lives in this warm winter place. Do they know children who have never seen snow? Ask: What kinds of plants does Sandy have? Do you see plants like these around you?

Page 75 · Birds in Warm Winter Places

Some birds go a long distance.
They fly back and forth.

Using the Illustration and Reading · Point out in the illustration the vesper sparrow, kingfisher, goldfinch, and red-winged blackbird. If your area is in a warm place like Sandy's, you might ask: When do you see new birds about you? When are they not with you? Where do they come from? What other animals do you see around all through the year?

Using a Globe · Perhaps you might use a globe to locate approximately where you live. Now locate a colder place or a warmer place. Birds that fly to these places for a season travel a long distance.

State departments of education, Audubon societies, or other state and local agencies often have information about local plants and animals that is very helpful. You may wish to make use of their films, filmstrips, and other suitable materials.

Pages 76–77 · What Changes Do You See in Winter?

Reviewing · These two pages are intended for review purposes. All the illustrations include concepts that have been developed in this selection. The questions on both pages will help to guide the children in their discussions. In answering these questions the children should make use of their own firsthand experiences as well as the information which they have read in *Science Around You.*

Materials Needed

For experiences and experiments suggested in *Science Around You:*

reading glass

For experiences and experiments suggested in this Manual:

frog or turtle	screened box
hot plate	square of glass, 4-inch
paints	terrarium
pan	thermometer
paper	tin lid

Further Experiences

The more firsthand experiences children can have of seeing, hearing, feeling, tasting, and smelling the better their concepts of science phenomena will be. Using printed symbols, or words, as in reading about these firsthand experiences, also is essential. Using word-symbols in their own writing is another important phase in the development of concepts. Language is an inherent factor in the development of concepts.

You may wish to use some of the following experiences to enrich your work with your children. These experiences should, of course, be used in conjunction with other related observations and experiments.

Sometimes you can tell from tracks in the snow whether an animal was running, walking, hopping, or fighting.

Observing Animal Tracks · Can animal tracks be seen in the snow around you? If so, can you help the children make their own hypotheses as to what the animals were doing when they made the tracks? Do the tracks themselves give any clues?

Using Animals in the Classroom · Is it possible to keep turtles, salamanders, tadpoles, or a garter snake in the classroom for a while during

the winter for closer study? These animals may not actually hibernate indoors, but the children will see that they are less active than in spring and summer. The best time to notice this will be after a cold week end. Have the children look at them then.

Children should be encouraged to bring these animals into the classroom only if they can care for them adequately. They should try to provide conditions comparable to those in which the animal lived outdoors.

Experimenting with Water · See water in its different forms. Winter is a good time for children to have this experience. First, they may bring snow indoors in a pan. It will melt, of course, changing from a solid to a liquid. Then, the children may boil the water and learn that some of it goes into the air in the form of steam, or a gas. Explain that water in this state cannot be seen, and that it is very hot. Children should *not* try to touch steam.

To complete the cycle, you may hold a square of glass or tin lid near the white vapor cloud above the steam so that the droplets of water will condense. You can then catch the droplets in another pan and place it outdoors. If the weather is very cold, the water will freeze into a solid again. From this experiment, you can help the children state their conclusions concerning three forms of water, namely, liquid, solid, and gas.

Observing and Recording · In many places the changes in weather conditions during the winter are dramatic. Therefore, winter is a good time to keep a weather record for a short time even though you may have previously planned and kept one. (See "Air, Water, Weather" in *Science Around You* for suggestions.)

Perhaps your children made a pictorial record of their observations during the summer and autumn seasons. Now they might paint another record to show cold winter days, how animals make changes in winter, and how plants make changes in winter; or warm winter places; or changes they observe around them. Writing short and simple stories about their observations of changes in winter should be within the abilities of your children now.

Evaluation

During the work with your children concerning winter did they show growth in their ideas of the adaptation of living things to changing conditions? Do they understand that in some places there are many changes during the winter and that in others there are few changes?

You might see considerable change in ideas and behavior in some children, while in others you might notice only a little growth. However, a small amount of desirable change can be significant for some individuals.

While using this chapter, did the children grasp the idea that plants and animals do not think and plan as people do? Are your children revealing a willingness to check their facts or differences of opinions by reading authentic material? Have they developed greater responsibility in using and caring for living things in the out-of-doors?

Does the vocabulary of your children reveal adequate use, for their level of maturity, of such new science words as *hibernate, fur, frozen, alive, fluff, year, north,* and *evergreen.*

You may wish to help the children collect pictures which reveal winter conditions in many places. As they give their explanations about their pictures you can note their growth in understanding of adaptation and change. They might organize their pictures for a bulletin-board display with such captions as:

There are few changes in winter in some places.

There are many changes in winter in some places.

Some places have cold winters.

Some places have warm winters.

Bibliography

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher,* New Edition, pp. 543–556, 595–610, 611–632. Ginn and Company, 1958.

For the Children

Adelson, Leone. *All Ready for Winter.* David McKay Company, Inc., 1952.

Gay, Zhenya. *Who Is It?* The Viking Press, Inc., 1957. Interesting illustrations of common animal tracks and text combine to ask the question, *Who is it?* The next page gives the information.

Podendorf, Illa. *True Book of Seasons.* Childrens Press, Inc., 1955. Presents simple, factual material about the changes in winter and other seasons. Tells how living things become adapted to changes.

Zim, Herbert S. *Frogs and Toads.* William Morrow and Company, Inc., 1950. Excerpts about changes and adaptations of frogs and toads may be read to the children.

Films

ANIMALS IN WINTER. (EBF) 1 reel, b/w. Shows how a variety of animals become adapted to changes in winter conditions. Some of the animals are caterpillars, owls, blue jays, badgers, and foxes.

BIRDS IN WINTER. (Cor) 1 reel, b/w and color. Shows the adaptation of birds, such as a chickadee, a nuthatch, a junco, a cardinal, and others commonly seen in winter.

WINTER ON THE FARM. (EBF) 1 reel, color. Reveals the seasons as they appear on a Wisconsin farm.

Filmstrips

IN THE WINTER. (YAF) color.

WINTER IN THE COUNTRY. (SVE) color.

VII

Sounds Around You

An infant's responses reveal the early growth and development of a child's reactions to sounds around him. He probably hears his mother's voice before he identifies his own vocalizations. Soon he becomes a creator of many sounds through his spontaneous babbling and endless banging of objects. He is probably startled by the sounds of his own making at times. Later he begins to interpret the sounds in his environment.

With each passing birthday the young child makes significant progress in his ability to interpret the sounds around him. He has many firsthand experiences with the sound of drums, spoons, clocks, and bells. He learns to recognize the direction from which sounds come and to use them to avoid unsafe actions.

By the time he is seven a child is ready for some further explanations or interpretations of his world of sounds. He hears the sound of rolling wheels, the whir of motors, the voices of people, the roll of thunder, the ringing of bells, and the blowing of whistles. He needs some explanation of these and other sounds to affect his thinking, guide his actions, and prevent or overcome fears which he may associate with them. Through firsthand experiences with sounds the child is enabled to enrich the meanings he receives from observation, reading, his association with others, and the events of the physical world.

As he matures he acquires an appreciation of the social significance of sound in communication. Perhaps as he matures he will form attitudes and values that will give him a basis for action toward noise distractions in our towns and cities.

Experiences with sound, both firsthand and those in *Science Around You*, will help children become more adequate in making explanations. The experiences may help them to have a feeling for or an idea of the meaning of energy although they may not use the word.

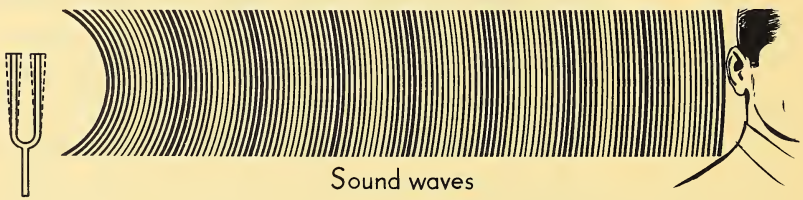
Science Meanings for Children

The following science meanings will contribute to an understanding of the large pattern of energy:

Sounds come to our ears through the air.
Some sounds are soft. Some are loud.
Sounds travel through the air and other materials.
You hear sounds when things move back and forth.
Things vibrate when they move back and forth.
Some sounds are noises and are unpleasant.
Some sounds are pleasant.
Sometime our cities may be less noisy.
Some sounds are useful.
They tell us how near or how far away something is.

Information for the Teacher

Sounds, like heat and light, are forms of energy produced by substances. Sound waves can travel through a substance, but the sound itself is not a substance. Waves travel in water when a stone is dropped into it. Sounds travel through the air in the form of waves in much the same way. The waves are a manifestation of energy.



The molecules of air move back and forth, or vibrate, when a tuning fork is sounding.

Sound is a form of energy. It is necessary to do work of some kind to produce sound. We do work when we blow a whistle, beat a drum, strike cymbals, speak, or sing.

You can feel a tingling sensation in your fingers when you lightly touch a piano or violin while it is being played. You can feel the vibrations of the stretched skin on a drum while it is being struck. You hear a high-pitched note when you strike a table fork on a table and quickly hold it close to your ear. Something is vibrating wherever a sound is heard. That is, something is moving back and forth or up and down when it is vibrating.

Ways of Working with Children

Pages 78–79 · You Hear Sounds

Sounds come to our ears through the air.

Experimenting with Sounds · You may wish to use this chapter when your children have some genuine concern, problem, or question to solve about sound. Or, you may wish to use it to open up a new area of experiences. Have the children scan the pictures in the entire selection to get the general idea of the chapter. Listen to their comments. Returning to page 78 read the title and recall experiences with drums as shown in the illustration. Ask: What are the children finding out about sound? What is moving when you hear the sound of the drum? Encourage the children to name the sources of sounds coming to their ears through the air. What sounds do they hear? Ask them what is moving when they hear the sounds.

Stating Hypotheses · Plan with the children to have on hand some of the materials shown in the illustrations. Could they make a drum as the two boys are doing in the illustration? They might stretch an inner tube over a nail keg. Other materials suitable for a drumhead are heavy paper, skins, or cloth.

Encourage your children to make up their own explanations or hypotheses about sound. Ask: How does the drum feel when you touch it? Does the drumhead jar or shake your finger when you feel it? Does the drumhead move when you strike it? How can you be sure that what you say is true?

Reading Directions · The content of page 78 can easily be brought out in conversation before reading it. Thus new words, such as *beat, drum,* and *finger,* will be used in discussion before reading the printed words. Guide the reading of page 78 by asking a question, such as: What are you to do as you beat the drum? What will you feel with your finger?

Let the children beat a drum and feel the drumhead moving. Note how lightly the girl in the picture feels the drumhead with one finger.

Should some children be unable to verbalize how their fingers feel, make use of the opportunity to reread the directions and then try the experience again. Your children may use such words as *shake, jar,* and *tingle* to describe their sensations. Since we are developing the concept of vibration, help them to use the word *move* also.

Checking Hypotheses by Experimenting · Help the children to discuss how they may change the experiment to show that the drumhead is moving when they hear the sound. The effects of the vibration can be seen by putting a spoonful of a fine material, such as sand, on the

drumhead as shown in the illustration on page 79. Ask the children: What does the sand do when the child beats the drum? What do you think those children want to find out? How can you test this idea? Encourage your children to check their hypotheses or ideas by doing the experiment.

Checking Experiment by Reading · "You Hear Sounds" may be read before doing the experiment. Guide the reading by saying: Read to find out why the children are using sand. You might also use questions from the group, or ask the children to read page 79 after experimenting, and then suggest that they check their experimentation with page 79.

Making Conclusions · It is unnecessary to use the word *vibration* at this point. First, help the children to develop the concept that sound is made when things move, and that when the sound reaches our ears we hear. You might help your children to record their experiment and such conclusions as: the drum moves when we beat it; the sand moved up and down when we beat the drum; we heard the sounds; sounds come to our ears through the air. Ask the children to check their conclusions with those in the last paragraph on page 79.

Pages 80–81 · Sound Goes into the Air

Some sounds are soft.
Some are loud.
Sounds travel through materials.

Discovering Loud and Soft Sounds · As your children refer to the illustration on page 80 help them to discuss what they see, such as, the boy is swinging the spoon; it strikes the table; and the string and spoon swing back and forth many times. Ask: What do you think the boy finds out? How can you be sure?

After the discussion of the picture ask the children to read to find whether this experiment makes a soft or a loud sound. To check the conclusion they will need to try the experiment unless you are willing to accept merely their verbalization.

Check the steps needed to perform the experiment by reading the first paragraph. Encourage discussion of the fact that sounds are going through the air in all directions and coming to our ears, and of the importance of good care of our ears. Ask the children to check their opinions by reading the last paragraph on page 80.

Making Predictions · On page 81 discuss the changes in the experiment as shown in the picture. Encourage children to make proposals or predictions as to what will happen now. Encourage them to make up their own explanations. Say, for example: Read the sentences that tell you what to do. Will you hear a louder sound? How can you be sure? Help children try this experiment.

Reading to Check Hypotheses · Have the children check their hypotheses by doing the experiment. Listen to their explanations. Ask: How can you be sure? Ask this question a second time after they have experimented. Note willingness to check their conclusions by reading the remainder of the selection on page 81. Ask them to compare their conclusions with those in the book. Thus you can help children to verify their own thinking by experimentation and by referring to authentic reading matter. This is another way to help children think objectively and to use an element of the scientific method.

Pages 82–83 · Sound Goes Through the Air

Sounds travel through the air in all directions.
We can direct sound in one direction.
Sounds go through other materials.

Listening to Sounds · Here you have another opportunity for first-hand experience. Experiencing precedes the use of printed symbols and the generalization that when things move back and forth they vibrate. With a clock on hand have the children note and discuss how far the ticking sounds can be heard; that the ticking sounds come through the air; and that the sounds go through the air all around them.

You might wish to help the children verify their thinking by having them read page 82. Help them to note the use of the stick in the illustration on page 83. Let them make proposals, such as: we can direct sound in one direction; and when sounds go through some materials we hear them better. Ask the children to check their conclusions by reading page 83.

Pages 84–85 · Some Things Vibrate

Sounds come from moving things.
You hear sounds when things move back and forth.
They vibrate.

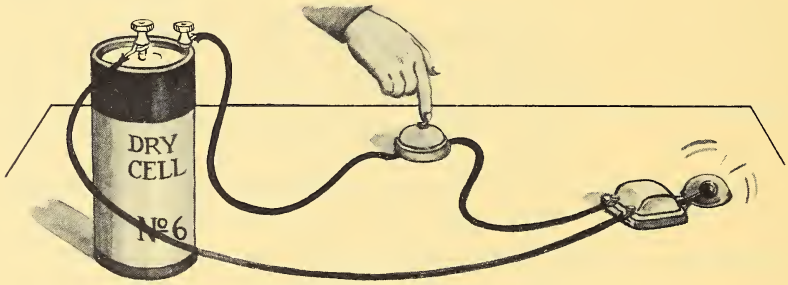
Discovering Vibrations · Make use of the clues in the illustration on page 84 to discover that some objects vibrate when you strike them. Notice how lightly the children touch the cymbal and triangle. Could your children use and tell of experiences with such instruments? Bring out in the discussion the fact that you can feel things like the cymbals move back and forth, in other words, that you can feel them vibrate. Use many other materials to discover what is vibrating.

The new words *vibrate, cymbals,* and *together* are sure to be used during the conversation.

Challenging Thinking · Some children tend to be verbal about *vibration.* You will help them to think objectively if you challenge them to demonstrate that what they say is true. Ask: How do you know this

to be true? How may we find out for sure? You may guide the reading of the first paragraph on page 84 to aid the children in doing an experiment or in checking their experiment after they have completed it.

Testing and Experimenting · Discuss the sounds of bells that you know at home or school. Notice the bell in the picture on page 85. Ask, for example: What makes this kind of bell ring? Point out the dry cell. Examine one if possible. Explain that when a dry cell and bell are connected the bell will ring. These materials may be set up ready for the children to use since the vibration of the bell is the important point here. Or with guidance the children may with the aid of the illustration set up the materials. Then have them ring the bell. Ask: How did the bell make your finger feel?



Reading to Verify · Use the ideas developed in previous experiments showing how moving things feel when touched; that they move back and forth; and that they *vibrate*. Ask the children to read page 85 to verify their conclusions.

Pages 86–87 · Sounds out of Doors

Some sounds are noises and are unpleasant to people.
Some sounds are pleasant.
Sometime our cities may be less noisy.

Discussing Outdoor Sounds · Discuss sounds you hear around you. What are the sources of the sounds? Note sources of the sounds in the pictures on page 86 after reading the title with the children. Ask: What sounds in the city do you know? What sounds would you like to hear less? What is the meaning of *vibrating*? Children may disagree as to which sounds are pleasant and which are unpleasant noises. Ask the children to read page 86 to find out about sounds in a city. Reread parts, especially the last two sentences. Listen to comments and note the children's attitudes toward and evaluation of noise in cities. What do they think about the possibility of having less noise in the world of tomorrow?

Use page 87 in a similar way. In the illustration note sources of sounds, including birds, water, bees, and leaves. Whether or not you attempt to distinguish between irregular and jumbled sound waves of noise and the regularity of the waves of a musical tone will, of course, depend upon the maturity of the children.

Changing Attitudes · It is not unlikely that children may express some fears associated with certain sounds, such as thunder, machines, or animals. Attitudes toward thunder, for example, might be changed as children learn something of the causes and nature of lightning and thunder and certain safety measures they can use. New ideas based on acquaintance with additional science facts may help to change attitudes.

Page 88 · Sounds Help Us

Some sounds are useful.

Stating Questions or Problems · Encourage children to discuss sounds that may help us. Do they mention sounds of warnings, time, work, or play? As you study each of the four illustrations ask such questions as: What do you see that makes sounds? Can you tell what is vibrating to make the sound? Do you hear sounds around you from things like those shown on page 88? How do you think the sounds help us?

Avoiding Gullibility · Do the children's comments concerning the last question above seem reasonable? Read page 88 to compare their ideas with those of the authors. Do the children agree or disagree? Can they give examples of sounds warning that something is near or that something is far away? Discuss the last question on page 88 of the textbook.

Page 89 · What Sounds Do You Hear?

Reviewing and Using Facts · 1. What vibrating things can be felt? Children may feel the vibration of vocal cords by placing their hands lightly on their throats. Sounds are produced when air from the lungs is blown through the narrow slit between the vocal cords in the throat. The vibration of the vocal cords causes the air column in the mouth, nose, and upper part of the throat to be set in motion.

2. If you are in a new place, ask the children to listen to see if they recognize the sounds which come through the air. Or the children may recall sounds they heard at some other time in a new place. These, of course, will be personal experiences which will vary among the children. Note whether they can name any of the vibrating objects associated with the sounds they heard.

3. Think of sounds you frequently hear around you. Do the children distinguish between the soft and the loud sounds? Do they generalize,

making use of experiments suggested on preceding pages, concluding that when things move back and forth they vibrate?

4. Take a walk outdoors and make a list of the sounds that the children hear. Note whether or not the children can identify the vibrating objects associated with these sounds.

Materials Needed

For experiences and experiments suggested in *Science Around You:*

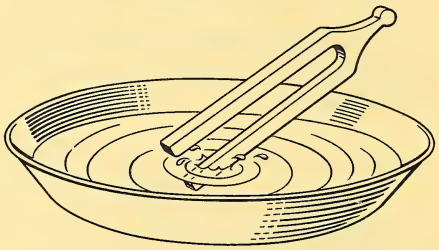
bell	drums	sand	triangle
clock	dry cell	string	wire
cymbals	push button	tablespoon	yardstick or stick

For experiences and experiments suggested in this Manual:

basin or dish flag or cloth tuning fork whistle

Further Experiences

These additional experiences may be used with the entire group or with small groups. Or they may be used to meet the needs or interests of individual children. An accelerated child or a child with a special interest might go further than the others with the study of sound, and report his findings to the entire group. You might expect a wide range of interest in sound as in other subjects.



Watching Vibrations · Sound is produced by the vibration of something. A tuning fork may be used to demonstrate vividly the movement or vibration connected with sound. Strike the fork lightly and quickly touch a prong to water. The vibration of the fork will cause the water to ripple. Tuning forks may be purchased from a scientific supply house. (See page 162 of the Appendix.)

Explaining Echoes · Children frequently ask for an explanation of echoes. Have your children listen to echoes while speaking in an empty auditorium or into an empty barrel or near a hillside, or after dropping rocks into water under a bridge and then away from a bridge. What explanation do the children offer about echoes?

Notice the differences between the sound of the voice and other sounds. Notice that when voices are reflected, or echoed, that their sound changes. Echoes occur when sound waves are reflected or turned back as they strike a solid object. Sound waves are reflected in a vacant auditorium by the walls and other objects just as they are by hills, bridges, and barrels in the outdoors. These reflected sounds are called echoes.

Learning About the Speed of Sound · Take the children to the playground or other large area and ask them to form into two groups about 500 feet apart. Give one group a strong whistle, and the second group a flag or a piece of cloth. Then explain that when the first group blows a blast on the whistle the group with the flag is to signal as soon as it hears the sound. The group with the whistle will observe that it takes some time for the sound of the whistle to reach the group with the flag. Repeat the experiment after interchanging the whistle and the flag.

Evaluation

It should be kept in mind that the spontaneous behavior of your children is useful in the evaluation of their progress in science. Has their interest in sounds around them increased? Do they make up their own explanations for these sounds? Do they listen to the explanations of others? Do they consider hypotheses made by other children? Are they willing to test hypotheses? Are they willing to consider new ideas and to accept new responsibilities? Are they becoming more resourceful? Can they state important conclusions from their own experiences?

You may wish to help your children organize what they have learned about sounds in a chart such as this:

Sounds Help Us

Near	Far Away
1. fire-alarm practice	1. motor boat in distance
2.	2.
3.	3.
4.	4.

Did you see evidence that individual children grasped to some degree the large pattern of energy developed in this chapter? Do they have some understanding of the fact that it takes energy and work to make sounds; that sounds move the air; that when things move back and forth they vibrate; and that some sounds are useful?

Organizing Ideas · Do you have evidence that children are making progress in using facts and ideas? They might make lists of facts from discussion, experiences, or reading. Preparing such lists helps children make generalizations and select supporting details for the main topic. You can help children see the relationships between the title and the supporting details.

Bibliography

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 800–823. Ginn and Company, 1958.

For the Children

Brown, Margaret W. *The Winter Noisy Book*. Harper & Brothers, 1947. About sounds, as footsteps on snow, the crackle of a fire, and snow falling.

Geralton, James. *The Story of Sound*. Harcourt, Brace and Company, 1948. Selected excerpts about many kinds of sounds and vibrations may be read and discussed with the children.

Podendorf, Illa. *True Book of Science Experiments*. Childrens Press, Inc., 1954. Provides simple and factual information about air and sound as well as experiments.

Podendorf, Illa. *True Book of Sounds We Hear*. Childrens Press, 1955. Gives explanations of common sounds.

VIII

Spring

From winter to spring children may see within a short span of time many outdoor things change. Their own activities too change in the spring. They can play outdoors later in the afternoon sunlight. They go to bed and get up in sunlight. Heavy winter coats, boots, and mittens are put away. Some of their games take on a seasonal aspect. Ice skates and sleds are put aside for kites and balls.

Children will enjoy exploring the events of spring with you. This is true whether you live in a city, on a farm, or in a suburb. In some regions children may look for and see crocuses even before all of the snow is gone. Red and green fluff on trees and shrubs seems to change quickly to young green leaves. Green becomes the color of spring.

The children tell of hearing the birds again at daybreak. They may see many young animals around. They may be puzzled because some are hatched from eggs while others are born alive.

In the spring opportunities for children to have experiences in their own environment seem almost unlimited. They can be found in the parks, woods, fields, ponds, brooks, their own school grounds, and yards at home. Children dig in the ground and find living and nonliving matter. They use tools and learn how to prevent their rusting. They listen to and identify outdoor sounds. They feel and smell the decayed leaves in a compost pile. They discover that morning and afternoon shadows are different from those in midwinter.

Children need teachers to help them develop concepts of their own environment. They need help in developing the skill to observe. And since language is part of concept building, children need help in the use of words to express their interpretations.

Children need help to learn how to think objectively and to state questions or problems from their observations. They need encouragement in restating their guesses as hypotheses. They need to be challenged to check their facts, and be able to give reasons for what they say by observing, experimenting, or reading. They need guidance in stating conclusions. All these science experiences should be pleasant ones for children.

Children see that plants grow under a variety of conditions.

Science Meanings for Children

You will note that three different regions are discussed in this chapter. Many children are curious and imaginative about places other than their own. This may account for so much interest in space travel. Children who have never seen a desert may like to see the illustrations of and to read about a desert. Thus you should utilize well the parts of *Science Around You* that deal with regions different from your children's locality.

One of the purposes of *Science Around You* is to enlarge children's vision with ideas of adaptation, variety, conditions necessary to life, and interrelationships. The following science meanings will help you to develop these large science patterns:

There are many changes in the spring.
Days are longer and warmer.
Animals are active in the spring.
Young animals usually have as much care as they need.
Most animals live in places that are good for them.
Plants make many changes in the spring.
In some dry places water flows through ditches (irrigation).
A few plants may be pulled from one place if there are many.
Plants should be left to grow outdoors.

Information for the Teacher

Developing Responsibility for Living Things · Children need help in developing a greater sense of responsibility for the living things which form a significant part of their environment. They will have a more intelligent sense of responsibility toward living things if they have some understanding of the patterns of adaptation and variety. To assist them in acquiring this understanding, a few of the many variations among plants and animals have been selected for consideration in *Science Around You.*

You will want to discuss many of the plants and animals around you. They are examples of living things that become adapted in many ways in order to survive. The chapter on "Spring" will deal with some of these ways. You may wish to help children increase their power of interpretation by observing and discussing many living things around you.

Plants in the Spring · Annual plants grow in the spring from seeds produced by plants that grew the previous summer. Food which is stored in the seed insures the growth of a new seedling. There is enough food within the seed for growth until the young plant makes its own food. Annuals have this way of perpetuating their kind. Children will be interested in the great variety in the size, shape, and color of seeds.

Perennials often have a large quantity of seeds also. But perpetuation of these plants is not as dependent upon each year's crop of seeds, since the parent plant lives for several years. In the case of some trees, in fact, they live for several hundred years. Help children to see that producing seeds is one adaptation of some species of plants.

Trees and shrubs develop flower and leaf buds during their growing seasons. The formation of the buds starts in the previous spring or summer but the buds remain dormant during the winter. As soon as favorable growing conditions return, however, the plants resume growth activities and the buds rapidly develop into leaves and flowers. Leaf and flower buds are examples of adaptation to seasonal changes.

Animals in the Spring · Seasonal changes also affect animals in many ways. The amount of sunlight and the temperature, as well as the availability of food, influence the activities of animals.

You can help children find out about ways animals survive under varying conditions. They can see how animal homes have been useful in their survival. Some birds, for example, build their nests high in trees, others on lower branches, or even on the ground. Some animals get protection in a home as well as a place to raise their young. These are only a few of the many kinds of adaptations of animals. Children do not need to use the word *adaptation* in order for you to recognize an increasing understanding of this larger pattern of thinking.

The length of time of parental care among animals varies, depending on the stage of development at birth and the length of time required to reach maturity. As soon as most animals can get food and protect themselves they are on their own.

Some animals bear their young in their underground homes where they have lived all winter. Ground squirrels dig burrows in open fields. There they raise their young. Skunks may raise their young in a den or hollow log where they hibernated on cold winter days.

The gray squirrel frequently lives in the trunk of an old tree in the winter. The young are usually born there in the early spring. In the summer a second nest is sometimes built in the fork of two branches. It is made of leaves, bark, and sticks, and lined with grass.

Birds have many enemies, such as cats, squirrels, skunks, snakes, other birds, and other animals. Birds usually construct their nests as inconspicuously as possible. Materials similar to those of the background are used. Nests are usually found near the place where there is food.

The Baltimore oriole builds a nest so that it hangs from the end of branches. The nest is constructed of plant fibers, hair, and string. A redheaded woodpecker pecks out a gourd-shaped hole and pads it with the chips. A whippoorwill constructs no nest but uses instead a slight depression in some leaves on the ground. The nest is found in a woods where it is protected by trees and other plants. The mallard duck builds a nest of reeds and grasses and lines it with down. It is built on the ground among high grass or reeds, usually near water. A ruby-throated hummingbird constructs a nest of plant-down with tiny pieces of lichen outside. A white-breasted nuthatch makes its nest in a deserted woodpecker hole high enough above the ground for safety. Nests of birds are usually found in places where food for the young is available.

Bird nests should never be disturbed. An old nest might be taken for study purposes after making sure that it has already been abandoned.

Ways of Working with Children

Pages 90–91 · Spring Is Here

There are many changes in the spring. Days grow longer and warmer.

Observing Children · You will surely want to begin the discussion of spring with the experiences your children are having in the outdoors around them. Do they sometimes feel irritated by heavy winter clothing and wish for warm spring weather? Do they ask when spring will come? What comments do they make about changes around them in the spring?

It is not necessary for children to identify the plants and animals shown on page 90 of *Science Around You*. The following information may be helpful to you, however, in answering children's questions about the illustration. The numbers on the sketch above correspond to the following:

1. Jack-in-the-pulpit
2. Skunk cabbage
3. Fern
4. Cattail
5. Mallard ducks and young
6. Robin

If you have followed some of the suggestions in the chapters about "Summer," "Autumn," and "Winter," you have watched through the seasons leaves turning to autumn colors and falling, leaf buds growing, and the apparent absence of such animals as toads, turtles, certain birds, chipmunks, woodchucks, and other animals commonly seen around you. Now the school grounds, parks, woods, ponds, meadows, and fields can become your outdoor place for firsthand experiences again. If this is not possible, watch the changes in outdoor living things through your classroom windows. Keep the larger pattern of variety in mind as you observe these changes with the children.

Seeing Changes in the Spring · You might wish to help the children compare changes in the autumn described on pages 12 and 13 with those in spring described on pages 90 and 91. Make similar comparisons of changes you see around you. Ask: What season do you think it is now where Mary lives? What makes you think so? What changes do you see? Ask the children to read page 90 to verify their ideas.

Help the children to see the changes pictured on pages 90 and 91. Do they notice that it must be warmer since children are wearing light wraps, that the crocuses are out, that the robin must be building a nest since it has a string in its mouth, and that there are ducklings with the mallard ducks now? Help the children to bring out that there is more sunlight, that the days are longer, and that it is getting warmer.

Reading to Check Interpretations · Now ask your children to check the changes they discussed by reading page 91. Ask: Why are the children in the picture outdoors? Discussing the ideas presented on these two pages should be an enjoyable experience and start a series of firsthand experiences. You might sharpen the children's observations with such questions as: What changes do you see around you? Are plants changing? Do they look the same as last week? Are animals changing?

Recording Changes You See · Deepen the concept of change which your children may have by helping them record some of the everyday changes they see, hear, smell, and touch. Ask them to watch for the unusual as well as the commonplace. They might keep a record for a week.

Changes We See Around Us

Some trees have red and yellow flufflike leaves.
The leaves will turn green soon.
The grass grows fast now.
Leaf buds are larger. Some have opened.
Mr. Brown plowed our garden today.
Kites fly. Birds sing. Violets grow.

Pages 92–93 · Birds Are Moving About

Animals are active in the spring.
Birds are moving about.
Some birds return in the spring.

Watching Birds Around You · Is there a thicket or woods nearby that you can call your own bird park? Can you go there often to look for birds? Can you go at different seasons of the year? If not, you can use the children's experiences while going to and from school as a basis for your discussion of birds in spring.

Help the children to recall the absence of birds around them during the winter. Ask: What do you think the birds are doing now that spring is coming here? Help the children to see in the illustration the flock of geese flying in formation high in the sky. You might ask where they are flying (north), and what might cause them to stop. Some birds stop to rest or eat before flying farther north.

On page 92 you see birds like those that have been in Sandy's warm winter place. They are a vesper sparrow in the foreground, a cedar waxwing, and a goldfinch on the birdbath. It is not important that children identify these particular birds. Rather, encourage them to describe the birds they have seen and where they saw them.

Checking Opinions · Children's opinions as to the kinds of birds they see will vary. You should expect differences of opinion among your children. Ask them to check their opinions by reading page 92. Suggest that they make a list of birds that will stay around your locality all summer and of any other birds they did not see in the winter.

Birds are noisy in the spring.

As the children look at the illustration on page 93 you may wish to ask: What do you think the birds are doing? Are they the same as the birds that are seen in the autumn? If the children do not recall which birds are seen in the autumn you may wish to refer to pages 20 and 21 again. Turning to their own surroundings, ask the children to note whether the birds around them now are doing the same things as the birds described on page 93.

The birds in this illustration are a robin on the ground, a bluebird flying, and a Baltimore oriole and a catbird on the tray. Children might learn the names of only those birds they can see around them.

Helping Birds · You might plan with your children to put out a tray of materials somewhat like the one on page 93. You might collect bits of down, thread, paper, cloth, and a container of mud, leaves, and twigs. Put the tray of materials in a somewhat secluded place, but where the children may observe birds using them. Help the children to record their findings.

Pages 94–95 · Young Birds in the Spring

Many birds build nests to raise their young. There is variety in nest construction.

Seeing Many Kinds of Nests · These two pages show a variety of birds in their habitats, their ways of nesting, and the variety in color, size, and number of their eggs. Look at the first picture on page 94. Have any of your children seen a Baltimore oriole's nest close up? Have they seen its construction of plant fibers, hair, and strings? Ask why this is a good nest for eggs. Read the first paragraph to be sure.

Use the second illustration by asking: Have you seen a bird like this one? What kind of a sound does it make? What kind of a nest does it build? Is this a good nest for eggs? Ask the children to check their ideas about the woodpecker with those given in the second paragraph.

Ask the children to look closely at the picture of the whippoorwill's nest at the bottom of page 94. Use your children's comments or questions to stimulate discussion or ask: Where does this bird make its nest? Why is this a safe place? Then read the last paragraph.

As the children look at the illustration at the top of page 95 ask them why the mallard duck builds its nest near water.

Call the children's attention to the hummingbird's nest. Discuss its size, shape, and construction, and the eggs shown in it. Study the white-breasted nuthatch's nest and the bird feeding its young.

Could you take a walk to look for these or other birds and their young around you? Help the children to see that what is good for one animal may not be good for another.

Observing Children's Behavior · During your walks in a park, on the school grounds, or in a wooded area, do any of the children stop suddenly to listen to a particular bird? Are any of the children becoming sensitive to the sounds of birds? Are they interested in a nest and eggs but careful to leave them alone? Do they tell about the birds they see around their homes? Do any of the children assume more responsibility in protecting birds? How do they try to protect them?

The purpose of the authors in including these experiences is to develop an increasing sensitivity to and appreciation of birds and their adaptations through the seasons. To accomplish this does not necessitate collecting a mass of facts and identifying birds in pictures. It *is* important that boys and girls learn how they can help protect birds.

Pages 96–97 · Other Animals in the Spring

Some animals have more than one home.

Seeing Different Habitats · Help the children see in the illustration some common animals that are around in the spring. Begin the discus-

sion by asking: Do you have animals in the spring that are different from those shown on pages 96 and 97? In what kind of habitats or places are the animals found? Do some live in or near water or marshy places? Do some live in deep shady woods? Do some live in fields, meadows, and open woods?

On page 96 note the nest above the water made by the muskrat. Explain that it is built of mud, roots, and stems in shallow water; that there is a room inside above the water line; that the muskrats store food inside the room; that the entrance is under this dome-shaped house; that the young are born in burrows along streams; and that the muskrat will fight other animals to protect its young.

Each young animal has as much care as it needs.

Discussing the Care of Young Animals · Help your children see the young animals shown in their natural habitats. The young skunks were probably born in the old log where the skunk hibernated on cold days. You may wish to refer to page 67 to recall that the skunk hibernated on very cold days but came out on warm sunny days. Note how the woods almost screen the deer and its young from view.

Bring out in discussion that the length of time the animals shown care for their young depends upon their stage of development at birth and how long it takes for the young to mature.

Looking for Young Animals · Encourage the children to tell about the care of any young animals they know. Could you plan a walk with your children to see what animals are around now? Ask the children to note what young animals they see, and how they are cared for. Daily or frequent walks are good experiences for children. Your discussions and observations outdoors should focus on the changes animals are making in the spring. Help the children to understand why they should not disturb animals. Read about the care of young animals on page 97. How do your children react to these ideas?

Pages 98–99 · Changes Around the School

There are many changes in the spring.
School grounds should be safe and clean.

Observing Changes Around School · Help the children to see many changes indicated on page 98 that also go on around a school in the spring. If appropriate, compare these changes with those around your school or those shown on pages 64 and 65 in *Science Around You*. Do your children see that the boys and girls in the picture are planting a seedling and filling a gully? What explanations do your children offer

regarding this work? How will filling the gully and planting seedlings help the school grounds?

Discuss whether or not you think these children like their school. Ask these or similar questions: How may we care for our school grounds? How may we make our grounds safe? How may we make them look better? What changes do you see on your grounds? Check your questions with those on page 99. What can you do about these problems or others on your school grounds?

Plants keep soil from washing away.
Weeds can be useful sometimes.

Preventing Soil from Washing Away · Help your children see that in the illustration on page 99 the soil is not washing away; that it has not been tampered with by people; and that it is a natural place of plant growth. Notice how naturally grasses and weeds grow at the left; that the next grasses and weeds are a little taller; that next there are seedlings growing, which probably started from seeds blown there by the wind; and that next there are full-grown trees.

Explain that the grasses and weeds grow first and are followed by a succession of larger plants, and that all these plants help to hold the soil. Could you try to find such a succession of plants around you?

Could you try to keep a place of natural growth near you for study purposes all through the year? Notice which plants come first, and what kind of larger plants grow next.

Pages 100–101 · Where Should Animals Live?

Most animals live in places that are good for them.

Taking Care of Animals · You may wish to have the children look at the three illustrations on these pages in sequence. Notice that in the first, the turtle is in its natural outdoor habitat, crawling in warm sunny sand toward water; in the second, the turtle is in the terrarium; and in the third, the turtle is outdoors again. Ask: What did the children do with the turtle? What would you do if you found a turtle outdoors? Suggest that they read page 100 to find out what Mary and Bob did with their turtle. Do your children think they cared for the animal well?

Ask your children if they agree with Bob's proposal to make a place for the turtle in a jar? Encourage your children to be critical of the place provided by Mary and Bob. Ask them to consider: Is it large enough? Can the animal move around? Is the jar like the place the turtle lived in outdoors? In what kind of place does a turtle live outdoors? After discussion, with an attempt to clarify the reasons for letting an animal remain outdoors, do your children agree with the last paragraph on page 100? Can they put these ideas into practice?

Should a frog, toad, turtle, garter snake, or some other animal be brought to school, perhaps you could test the action of the children. Make a place for the animal to live where it will have as suitable conditions as possible. Do the children intend to keep it for a day or two and then return it to its wooded environment? This is a good practice concerning all wild animals brought to school.

Pages 102–103 · Changes in the Spring

Plants change in the spring.
Leaf and flower buds open in the spring.

Watching Changes in a City Park · Call attention to the fact that the illustration on page 102 shows spring in a park which is in Betty's city. Ask: What changes from winter to spring do you think Betty can see here? Then ask the children to read the first paragraph on page 102 to check their comments.

Use the last paragraph to guide the children's observations during a trip outdoors. Look at flower and leaf buds through a reading glass if possible. Many children using *Science Around You* will be living in cities where the parks will offer interesting opportunities to observe many of the changes that plants make in the spring.

Using the Out-of-Doors Wisely · Have the children examined leaf buds several times during the autumn and winter? You might help them to select a few specific branches with buds to watch. They can see when the tiny leaves begin to develop. They may discover that some of their buds are flower buds.

A few twigs with buds might be brought indoors to open where they can be examined more closely under the reading glass. Only a very few twigs should be taken and not many from the same place.

On page 103 you will see the green grass and read that the roots lived through the winter. Can you examine some roots where grass is still brown? Leave the ground and grass in good condition so that the soil will not wash or blow away. Examine the spot later to see if the roots were alive and grew.

Examining Bulbs · Help the children to open a bulb as suggested in the last question on page 103. Make a list of the parts of a bulb plant, both inside and outside the bulb as shown on page 103. Use your reading glass to see the new plant inside the bulb. Ask the children to check their ideas by reading page 103.

Use the cross section of the bulb to associate such words as *bulb, roots,* and *new plant* with the parts. After you open a bulb and examine

the parts, could you make charts showing the whole bulb and also a cut section of it with the parts labeled?

Pages 104–105 · Spring in the City Park

Living things change in the spring.
People in the city want birds.

Using a Park Wisely · It is the responsibility of the school to help acquaint children with some of the facilities that a city offers. Perhaps the group might select a part of a park to watch and call their very own. They might become observant enough to note changes that occur there, such as tree buds swelling, leaves developing from buds, the grass becoming green, flowers growing, migrant birds stopping to rest and eat, and other birds nesting, laying eggs, and raising young, and the sources of their food and protection.

As the children make these observations in the park note their behavior. Do they use the out-of-doors wisely? Do they have pride in their city park?

On page 104 you can see a chipmunk with her young. Do your children see chipmunks around them? Did they miss the chipmunks while they were hibernating in the ground on cold winter days?

On page 105 you can see sparrows and pigeons. They were in the park during the winter, too. At the left you can see the migrating goldfinch, and at the right, a flicker. Read pages 104 and 105 to find out more about birds in a city park.

Developing Attitudes · Children should be helped to feel responsible for the environment and to take pride in the natural beauty of their region. Children are young citizens who can be helped to care for a park, its plants, birds, and other animals, and to know that people want these living things in their city parks. Do your children refrain now from picking flowers, pulling off leaves, and breaking limbs of a tree? How do your children react to the second paragraph on page 105?

Pages 106–107 · Spring Comes to a Dry Place

In some dry places water flows through ditches.
The water comes from far away.

Getting Water to Dry Places · Point out to the children that this section tells about Tom's place where it is hot and dry. Ask: What time of the year is it on Tom's farm now? How do you know that it is spring? Compare and discuss changes you see here with those on pages 8–11. Help the children to see that Tom and his father are working in the garden; that they are letting water into some of the ditches; that the garden is green and growing where there is water in the ditches;

and that the water comes from far away. Ask the children to read page 106 to check their comments.

Do you live on or near an irrigated farm? What firsthand experiences concerning irrigation can your children tell about? Can your children show their interpretations by making large pictures?

There is some rain in dry places in the spring.
There are many flowers for a short time.

Some children using *Science Around You* may live near a desert and see cactus plants in bloom like the ones on page 107. Other children may have traveled over a desert after the spring rains. Children may be able to bring pictures of desert flowers. Ask: How do the plants get water to grow? How does Tom's garden get water? Ask the children to read page 107 to verify their ideas.

Bring out in your discussion such facts as: seeds are in the desert sand during the winter; in the spring the sun and rain make the seeds grow; after a rain the soil may be covered with flowers; after the plants bloom seeds form; and these seeds, in turn, lie in the sand until the next spring rains come.

Pages 108–109 · Spring in Many Places

Reviewing and Summarizing · The purpose of these two pages is to help children recall the three widely different regions described in *Science Around You*. Encourage your children to look at the illustrations of Mary's, Tom's, and Sandy's places on these two pages. What can they tell about these three places? Help them to observe more closely by asking: Which place is most nearly like yours?

Do the children know that some places are different from their own place? Do your children live in a place of few changes? Do your children live in a place of many changes? Do they know that in some places the land is irrigated? Do your children show an interest in places other than their own? Do you think their concept of space is expanding?

When there are many plants in a place a few may be taken.
When plants are taken they should be cared for.

Using Plants Wisely · In the first illustration on page 108 Mary is looking at the flowers. Ask: What do you think Mary is thinking about? Why do you think Mary should not pick these flowers? The responses may vary.

Bring out in discussion that there are only a few of these flowers, and that if these are not picked there will be seeds to make new plants. People should not pick flowers when there are only a few. Now read the first paragraph on page 108 to see what Mary actually did. Do

your children agree or disagree with Mary? What experiences can children tell about which reflect other attitudes? The second illustration and paragraph show that when flowers are plentiful, a few may be taken.

Do your children put ideas about wise conservation into practice? Children need many opportunities for firsthand experiences with conservation practices and with planning and evaluating such practices in order to change their behavior patterns. Have your children had these opportunities where you could observe any changes in their behavior along these lines?

Materials Needed

For experiences and experiments suggested in *Science Around You:*

onion or tulip bulbs
terrarium
tree seedling

For experiences and experiments suggested in this Manual:

baking dish, glass
gardening tools
nest-building materials, e.g., cloth, down, leaves, paper, string, twigs
onion bulbs
paints, cold-water
paper, 4′ × 15′
reading glasses
seeds, Lima-bean, lettuce, popcorn, pumpkin, radish

Further Experiences

Children in your group may vary widely in individual interests and abilities. You may wish to use some of these experiences to care more adequately for individual differences among your children.

Recording Experiences · Make a calendar or keep a diary of events similar to the ones shown here.

Birds We See Around Us

Date of Arrival		Where We See Birds
May 1	Baltimore oriole	top of elm tree
May 3	mallard duck	near the pond

Changes We See in the Spring

March 15	crocuses in schoolyard
March 26	leaf buds opening on willow tree
March 27	robin getting strings from tray
April 1	earthworm in our garden

Making a Garden and Watching Changes · Discussion and planning should take place before the actual gardening begins. There can be indoor experiments with sprouting seeds, propagation of plants, collecting and learning how to use tools and how to care for them to prevent rusting, and deciding upon a garden spot with an adequate amount of sunlight and drainage.

Then seeds and bulbs might be planted outdoors in the selected spot and the plants harvested and used before school is out. These might include lettuce, radishes, and onion sets. Seeds of other plants, such as popcorn and pumpkins, might be sown at the same time and harvested and used by the children during the following autumn.

Digging in the Ground · As the children work in their garden or in other suitable soil encourage them to look for the variety of things that are in the soil, including earthworms, larvae of insects, hard and soft rocks, roots of plants, tiny living plants, and decayed leaves or stems. Use reading glasses to examine the contents of the soil more closely. At first the children may tend to remove the earthworms. Help your children see that the earthworms are helpful because they help to keep soil soft so that air can enter it more easily. Then they will understand why they should leave the earthworms in the soil.

After digging up any ground, the children should smooth it over or plant it so that the soil will not blow or wash away. Leaving the place used for digging in as good or better condition than they found it gives children an opportunity to use soil wisely.

Watching Seeds Sprout · Experiment with large seeds, as bean, pumpkin, or Lima-bean seeds. Place crushed wet paper in a glass baking dish. Place the seeds on the paper so that they can be seen. Keep the paper moist. Then watch stems and leaves grow up, and the roots grow down. When the seeds have sprouted, open one to see the young plant inside. Food is stored within each seed for the early growth of a plant.

Observing Bulbs Grow · Examine the outer and inner layers of a bulb. Open an onion and examine its inner part. Place another onion in the top of a tall glass filled with water. Watch the roots and stem develop. Record your observations.

Watching Insects That Make Changes · If the children find a cocoon that still contains the pupa, they might bring it into the classroom in order to see the moth emerge. A cocoon may be brought indoors for study in the spring if the weather is warm. Then the moth may be released into the out-of-doors when it comes out. The children should understand the reason for bringing the cocoon in now rather than in autumn or winter. The cocoon should be carefully suspended so that

when the moth emerges it can spread its wings. Record the children's observations of the moth emerging.

Evaluation

Work with the four chapters on the seasons has called for many trips outdoors. Have your children gradually made progress in their ability to move as a group while on an instructional trip? Children usually need help in distinguishing between free playtime outdoors and a trip which has a study purpose. Do you see less tendency to pull plants up? Are your children more inclined to leave things outdoors where they belong?

Another way to evaluate the progress of children is to have them make a large picture or mural. To do so calls for planning, selecting, and organizing ideas, as well as expressing them. Several themes might be selected for the pictures, for example, plants we see around us in the spring; animals around us make changes in the spring; there are many young animals; some animals have much care; and people make changes in the spring. Discussion of and planning the pictures will necessitate recalling details and grouping related facts. Thus children will have an opportunity to use what they have learned with a new purpose. In such an activity, science meanings, attitudes, and language power are revealed to you. You will want to determine each child's contribution and his progress.

Have you seen other evidences of changes in behavior? For example, are your children curious about places other than their own locality? Has this curiosity contributed to their concept of space? Do they understand to some degree that plants and animals are adapted to living under different conditions?

Bibliography

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 479–486, 539–556, 580–632. Ginn and Company, 1958.

For the Children

Blough, Glenn. *Who Lives in This House?* Whittlesey House (McGraw-Hill Book Company, Inc.), 1957. While listening to this story about who lives in an old abandoned house, children will learn about robins, wasps, squirrels, bees, spiders, and skunks.

Cormack, Maribelle. *The First Book of Trees.* Franklin Watts, Inc., 1951. Some selections about a great variety of trees may be read to and discussed with the children.

Exler, Samuel. *Growing and Changing.* Lothrop, Lee & Shepard Company, Inc., 1957. Describes night changing into day, the sun in different positions in the sky, and other changes.

George, Jean. *The Hole in the Tree.* E. P. Dutton & Co., Inc., 1957. Two farm children observe the life in a hole of a tree and find out about a bark beetle, a downy woodpecker, a carpenter bee, a chickadee, and other animals.

Goff, Lloyd Lozes. *Run, Sandpiper, Run.* Lothrop, Lee & Shepard Company, Inc., 1957. Text and illustration will contribute to a better understanding of this beach bird.

Podendorf, Illa. *True Book of Animal Babies.* Childrens Press, Inc., 1955. Presents simple and factual material about young animals, how they change, how some need care, and how others care for themselves.

Podendorf, Illa. *True Book of Trees.* Childrens Press, Inc., 1954. Gives information about a variety of common trees, including their uses.

Podendorf, Illa. *True Book of Weeds and Wild Flowers.* Childrens Press, 1955. Gives information about plants through the seasons and the importance of the conservation of plants.

Webber, Irma E. *Bits That Grow Big.* William R. Scott, Inc., 1949. Simple factual materials about plant reproduction.

Williamson, Margaret. *The First Book of Bugs.* Franklin Watts, Inc., 1949. Excerpts about a great variety of insects may be read to and discussed with the children.

Zim, Herbert S. *What's Inside of Plants?* William Morrow and Company, Inc., 1952. The large type on some pages and some illustrations will be useful when discussing what is inside leaves, roots, and plants.

Films

BABY ANIMALS. (YAF) 1 reel, b/w. Explains the degree and nature of parental care, resemblance to parents, variation in ability to care for selves, and that some young are hatched from eggs and others are born from the body of the mother.

SPRING ON THE FARM. (EBF) 1 reel, color. Shows the adaptation of plants and animals to the changing seasons.

WONDERS IN THE DESERT. (C-W) 1 reel, color. (See film list for Chapter I.)

Filmstrips

IN THE SPRING. (YAF) color.

PLANTS AND ANIMALS IN THE SPRING. (SVE) color.

IX

Friction

Long before the seven-year-old entered school, he had experiences with friction. He has been learning through manipulation since babyhood. As an infant he crawled over a floor or rug and explored the difference between a rough rug and a smooth floor. He responded to smoothness and roughness. He became sensitive to the smoothness of ice, a tin pan, or cotton clothes.

As a younger child he learned to explore space around him during his play outdoors. He became sensitive to thick soft grass or a sandy rocky spot. Some rocks were smooth; others felt rough. Often he slipped and fell. He may have felt unhappy because his skin was scratched when he fell.

The young child soon learns to manipulate all kinds of toys. He pushes or pulls them over rough and smooth places. At first he may have played with a sliding train or car. Then he pulled a wooden train with wheels by a string. He learned that smoothness or roughness of the surfaces made the sliding, pushing, pulling, or rolling either easier or harder to do. With each birthday he made a greater use of friction as he played with new toys.

By the time he is six or seven he has made great strides in using or overcoming friction. He plays with a train on smooth tracks. He learns to use skates, sleds, and sometimes a bicycle. He likes to slide on smooth surfaces but he has learned the advantages of wheels, also. By this time the growing child has become sensitive to the fact that rubbing surfaces cause wear. He has seen holes in shoes and at the elbows and knees of clothing. He may have noticed the worn places on steps as he has gone up and down.

Children using the selection on "Friction" in *Science Around You* will need help to understand the meaning of and to become verbal about friction in their everyday experiences. Much of their learning has been through touching and feeling and other sensory experiences. You can help them to use words to interpret these experiential learnings about friction. With your help they can make interpretations and can give their own explanations.

Science Meanings for Children

Help your children to plan their science experiments with you. Watch for evidence of their growth in co-operative planning. As you plan and work in this area of friction the following science meanings will contribute to an understanding of the large science pattern of energy:

Some things are rough. Some things are smooth.
Rough things rub more than smooth things.
Rough things make more friction than smooth things.
Rubbing makes things warm.
There is friction when things slide together.
Sliding things rub hard.
Brakes make things stop.

Information for the Teacher

People take friction into account in many everyday experiences. For example, they walk more carefully on a wet pavement than on a dry one. They put casters on furniture that is to be moved frequently. Many things people do are modified in some way by friction.

Energy · Objects in motion tend to keep on moving. Objects at rest tend to remain motionless. Energy is needed to start and to stop objects. Energy must be exerted also to overcome friction if objects are to be kept moving.

The brakes used on trains or cars supply the necessary friction to stop these moving vehicles. Children use brakes on wagons and scooters. The friction in these instances may be applied by a stick pressed against the wheel or by the children's feet dragging on the ground.

Smooth and Rough Surfaces · We all know that when two rough surfaces rub together there is resistance, or friction. The rougher the two surfaces are, the greater is the friction, or the resistance, encountered. In fact, when the surfaces of two objects rub together, they may become warm or even hot. The heat represents the energy used to overcome the friction.

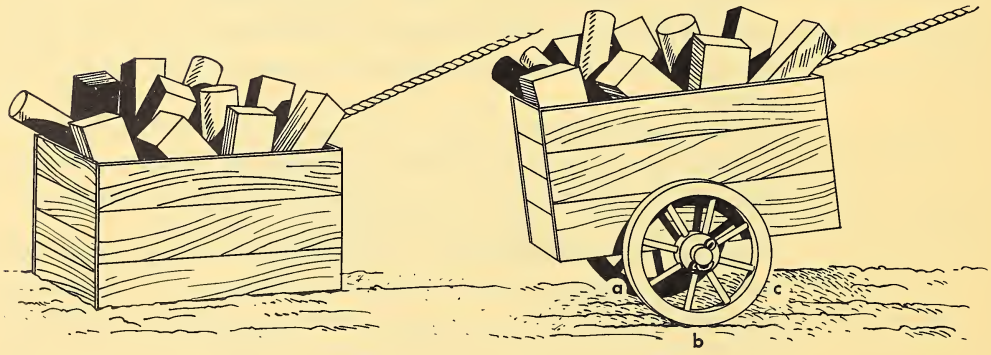
It takes energy, for example, to overcome the resistance, or friction, that takes place when you pull a nail out of a piece of wood. The nail feels warm when it comes out. The warmth represents the energy used to overcome the resistance, or friction, of pulling the nail out of the wood.

A sled will not slide long unless we use energy to push or pull it. It stops because there is friction between its runners and the ice. There is some friction even on smooth ice. The rougher the two surfaces are, the greater the friction.

Gravity is also a factor in considering the amount of friction between two surfaces. When we pull an empty box across the floor, there is friction. If we load the box heavily, it is much harder to pull across the floor because gravity is operating on the contents of the box as well as on the box itself, just as it is on everything else on the earth.

Many surfaces look smooth. Surfaces of the skin, certain metals and cloth, different kinds of wood and floors, for example, may look smooth. Under a microscope or reading glass, however, they look rough. This roughness is useful in providing a source of friction. For example, when we walk there must be friction between our shoes and the walking surface to enable us to move forward. This is illustrated when we try to walk on ice or a waxed floor and find ourselves slipping. The smooth ice and the floor made smooth by wax do not create enough resistance to the soles of our shoes to enable us to push forward or to prevent our slipping.

Sliding and Rolling Friction · You can observe two kinds of friction. They are sliding and rolling friction. Two surfaces rubbed together, as when a chair is pushed over the floor, produce sliding friction. Two surfaces coming in contact by rolling one over the other, as when a baby carriage is rolled on the floor, produce rolling friction. Using wheels changes sliding friction to rolling friction.



This box rubs against the floor at all points of contact. Here there is much sliding friction.

Here the wheel touches the floor only at point *b*. Points *a* and *c* do not touch the floor when *b* does. These points roll over the floor.

The wheel is one of man's great discoveries for decreasing the friction he works against. There is some friction between a wheel and its axle but it is less than that between a wagon without wheels and a road. Friction is further reduced by lubrication of the axle.

Ways of Working with Children

Page 110 · Smooth and Rough Things

Some things are rough.
Some things are smooth.

Examining Surfaces · Could the children examine and tell about rough places on toys or other objects that have been rubbed smooth? Try to find out the ideas of your children about rubbing smooth and rough objects. While their ideas may not always be correct, children should be encouraged to express what they know and think.

Introduce the title of this chapter, "Friction," after the children have had some firsthand experiences with and discussion of *friction* produced by rubbing two things together.

You might ask: What do you think the children shown on page 110 will discover about rubbing the objects on the table? Can you examine similar objects? You might wish to examine the smoothness and roughness of your objects under a reading glass. Can the children see little holes, spaces, or rough spots on surfaces?

Examine some sandpaper. Are there differences of opinion about its smoothness and roughness? If so, ask: How can you be sure about what you say? Suggest that the children read the first paragraph on page 110. In answer to the two questions they might group their objects into a smooth group and a rough group. How do your children state their conclusions about the surfaces of objects? Ask them to check their conclusions with those on page 110.

Organizing Learning · Making a chart similar to the one shown here is one way to help children organize facts and conclusions. Some children need opportunities to carry out the organization of simple material.

Smooth and Rough Things

Smooth Things	Rough Things
skin	wood
silk	wool
glass	pavement
ice	sandpaper

Pages 111–112 · Rubbing Warms Things

Rough things rub more than smooth things.
Rubbing makes things warm.

Checking Predictions · It will probably be worth while to have the children do some sawing at this point. Ask them for their explanations

of what it is that rubs when they use a saw. Ask: Is it harder to saw wood than to rub other things together? Or, you might use questions and comments from their discussions.

Discuss rubbing that occurs in sawing wood or sandpapering. Compare it with rubbing of things that slide easily. Ask: What do you think will happen when the rough wood and rough saw teeth are rubbed together? Encourage predicting. Ask your children to tell about their own experiences with sawing wood. Do they mention the fact that the saw gets warm as it goes back and forth? It is very likely that they will not. In that case, ask: What happens to the saw when it rubs the wood?

Now read page 111 to see if the points you have discussed agree with this selection. Encourage the children to show that rubbing makes heat.

Help the children to interpret the situation in the first illustration on page 112. They will no doubt say that it is a cold winter day, and that Bob and Mary are dressed for cold weather. But interpretation is more than just describing. You may need to guide their thinking a little more by asking: What are they doing to keep warm? Then read the first paragraph to find out for sure. Can your children give other examples of rubbing that produces heat?

Encourage your children to express their ideas about this question by asking: With what does Bob seem to be rubbing the table? What will happen to his fingers and the table? Ask the children to read the first paragraph to check their comments. This experience suggests the value of having children use familiar objects and experiences in their experiments.

Read the last two sentences on page 111. Could your children carry out the suggestion given there? Do children who are verbal about the effects of friction show a willingness to check their conclusions by using these materials?

Pages 113–114 · Moving a Heavy Box

There is friction when things slide together.
Sliding things rub harder than rolling objects.

Planning with Children · When you need to move a heavy object, such as a box of blocks, rocks on the school grounds, or a box of books, make solving the problem a learning situation. First, identify the problems of how to get the load lifted, how to move as one load rather than piece by piece to save time, and how to make the work easier. Encourage questions and hypotheses, such as: How may we move the box of lumber easily across the room where we want to work? What holds the box? The box is hard to move because something is holding it. Find out what other problems the children have. How do you think the children feel? Why are they having trouble? How would you move the box?

Suggest that the children read the explanation on page 113 to find out what is holding the box. When they have finished reading, take time to let the children give their explanations about friction. Add to the children's interpretation, if necessary, such factors as the weight of objects, the roughness of surfaces being rubbed, the amount of energy used, the pull of gravity, the greater friction offered by sliding objects, and the work done when an object is moved.

Stating Hypotheses · Do the children suggest hypotheses? Ask: How do you think we may overcome this friction? Listen to the hypotheses of your children. They may state their hypotheses as suggestions, such as: Move the box by pushing and pulling harder. Have more children push and pull. Move the box by lightening the load a little. Encourage the children to make their own explanations. Let them try out their hypotheses to find out whether or not they work. It will not be necessary to tell the children that their hypotheses are incorrect if they can discover this by trying them out.

The rock acts as a pivot point for the lever.

Use page 114 to help the children get ideas for overcoming friction. Note that Bill is using a lever to raise the edge of the box; that the rock acts as a pivot point for the lever; that other children have broomsticks; that the children are doing work when the box moves; and that it takes energy to do this work.

Ask: Do you think the rollers will help move the box? How do rollers help? Is there more or less friction when rollers are used? Then ask the children to read the first paragraph to check their conclusions. Do your children agree that there is less friction between rolling objects than between sliding objects?

It takes energy to do work.
There is less friction in rolling objects.

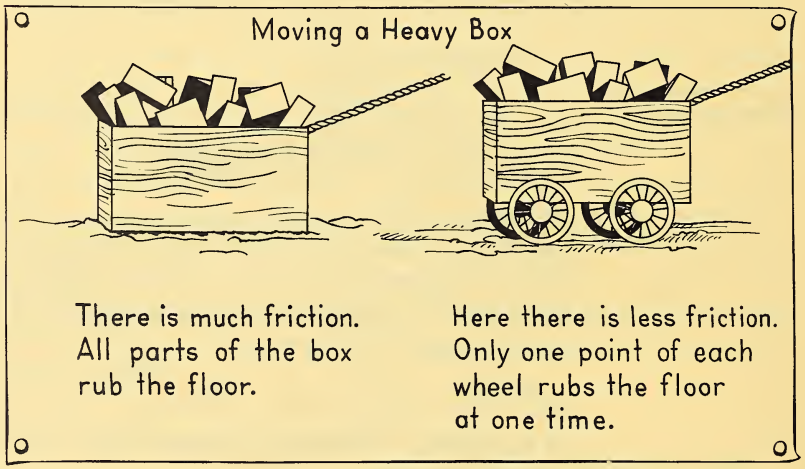
Experimenting with Rollers · In case some of your children question the use of the broomsticks as rollers, you will have an opportunity to ask them to help get similar materials and try this experiment. Ask: How can you show that what you say is true? How can you be sure? Some children may be asked to show others how rollers reduce the sliding friction. Do your children reveal an attitude of being willing to experiment, thus being able to present evidence in their explanations?

If you are trying to use rollers under the box and children have diffi-

culty in using them and in figuring out where to put the rollers, refer them to the second illustration on page 114. Ask: Now where do you see the rollers (center and back)? Where is Mary putting a roller (front)? Who is pulling the box? Does anyone have to push the box now? Has the box moved more? Does it take more or fewer children to do the work of moving the box with the rollers?

Read and discuss the last paragraph to clarify that the rollers roll over the floor; that the heavy box does not rub the floor; that there is less friction with the rollers; and that fewer children can move the box.

Explain that things which roll, such as balls and wheels, do not rub surfaces on which they are moving as much as do flat objects. Help your children to see that we overcome friction by putting wheels on wagons, skates, and many toys. The children might arrange a bulletin board with pictures to show this. Could they write simple explanations for what they are showing?


Moving a Heavy Box
There is much friction. All parts of the box rub the floor.
Here there is less friction. Only one point of each wheel rubs the floor at one time.

Could someone make a sketch for a chart showing a loaded box sliding over the floor? Write a caption for this illustration. Then make a sketch of a box on rollers or wheels, and write an appropriate caption for it. Encourage children to give suggestions for captions.

Page 115 · Brakes Stop Things

Brakes make things rub.
Brakes make things stop.

Making Use of Friction · Ask your children if they have used a stick to help stop a wagon, as the boy is doing in the illustration. Could some-

one bring a wagon to school and show how a stick can become a brake? Ask: What does the stick rub? What does the wheel rub? What stops the wagon? Discuss the fact that you make use of friction when you stop the wagon with the stick by causing two rough surfaces to rub together.

Reading About Brakes · Now read the first paragraph to see how the points of your discussion compare with those in this selection. Do your children understand the sequence of ideas in the text?

Help the children to note the car in the background. In your discussion of how brakes stop this car, point out that the brakes rub the wheels, that the wheels rub the ground, and then the car stops. Help to make clear that we make use of friction when we stop a car.

Could you observe with your children the rough treads on tires? Discuss the fact that in order for the car to move there must be friction between the tires and the road; that tires with a good tread offer more friction than old tires worn smooth; and that a rough tread will prevent the tires from sliding so far when the brakes stop the wheels.

Page 116 · Friction Around You

Friction is useful.

Reviewing · Pages 116 and 117 are planned to aid you in helping your children summarize or generalize about what they have been studying in this selection. Read the two questions at the bottom of page 116 with the children in order to help them know how to interpret the illustrations.

Help to make clear that in the first illustration the wheelbarrow moves with less friction than the box because it is rolling on a wheel.

In the second illustration at the top of page 116 note that there is little friction between the skate and the ice because the ice is so smooth. Discuss that even on the smoothest ice, however, skates will not slide far unless the skater pushes or unless he is sliding downhill. The skater stops because there is friction between the skate runners and the ice. Explain that when an object presses on ice, some of the ice melts. The runners on the skates press on the ice and melt it a little so that there is a little water under the runners which helps to make the friction less.

Note that in the last illustration the box causes the most friction of the three objects shown because it is sliding over the rough floor.

Painting What You See · Use the questions on page 116 to help the children become more observant of the need for and use of friction around them. They might wish to show on a large mural all the ways of using friction that they can discover. They might show their interpretation of such things as a workman putting sand on a road, a car with chains on the wheels moving over ice, children wearing rubber-soled

shoes while playing on a gymnasium floor, nuts staying on bolts, nails holding fast in wood, or any other situation where something is done by friction.

Page 117 · Making Things Stop

Reviewing · Read the title and the question at the bottom of the page. Encourage the children to give their interpretation of the action in the pictures. Note that the boy on the bicycle uses its brakes; that the child on the scooter uses his foot against the ground as a brake; and that the rough tread on the tires, as well as the brakes, helps the truck to stop.

Explain that the brakes rub against the wheels, that the wheels rub hard against the ground, and then the object stops. In each instance, the friction made by rubbing two rough surfaces together is useful. Encourage and help the children to relate their own experiences and observations to those shown on this page in answering the question, "What makes these things stop?"

Materials Needed

For experiences and experiments suggested in *Science Around You*:

- box, large wooden
- brakes, bicycle, wagon
- broomsticks, 3
- rope, 3′ or 4′ long
- rough materials, e.g., sandpaper, saw, wood, wool
- smooth materials, e.g., cotton or silk, glass, ice, tin plate
- stick for brake
- wheels, bicycle, toy, wagon
- wood to saw

For experiences and experiments suggested in this Manual:

- boards
- book and sheet of paper
- box, large wooden
- materials for friction test, e.g., buttons, coins, metal, woolen cloth
- paints, cold-water
- paper, about 4′ × 15′
- reading glasses
- sandpaper
- toy car or express wagon
- worn materials, e.g., chalk, clothing, shoes

Further Experiences

You may wish to provide extended experiences for accelerated children or for all the children. If so, provide time for them to share and demonstrate to the other children their findings regarding these additional experiences.

Starting and Stopping Things · Energy must be used to start and stop objects. To experience this fact the children can use their own energy

to move a wagon. First, have them push or pull a loaded wagon on a level surface. They will notice that it is harder for them to start the wagon than to keep it moving. Help them to notice also that the quicker they try to start it, the more energy is needed, and the harder they have to pull. Then have them try to stop the wagon quickly. The quicker they stop the wagon and the faster it is moving, the harder it will be to stop it.

Stopping Quickly · Energy is needed to stop quickly. Encourage children to tell about their experiences running and stopping quickly. How do they feel?

You might wish to draw a line on the floor. Then suggest that a child run up to the line and try to stop suddenly. Does the upper part of his body continue to move forward although he may be able to stop his feet?

Talk with the children about sliding and coasting. Do they notice that once they are moving, they tend to keep on moving and that once they are at rest, they tend to remain motionless? This tendency of moving objects to keep on moving and those at rest to remain still is called inertia. Inertia enables the children to coast and friction finally stops them.

Testing for Friction · Different kinds of materials can produce different amounts of friction. Collect many kinds of materials, some with rough and some with smooth surfaces. Group the materials according to their surfaces, then test them for friction.

Let children pull each other in a box, or push an empty box on the floor, a rug, a paved sidewalk, or ice. Ask the children to notice the difference in the energy required to push the box over different surfaces. Thus they can determine for themselves that there is greater resisting force, or friction, exerted under some conditions than under others. What is their interpretation of their experiments?

Decreasing Friction · There is less friction between rolling objects than between sliding objects. To demonstrate this fact push a loaded box along the floor. Then move the same loaded box in a child's express wagon. The rolling friction exerted when the loaded box is moved in the wagon is much less than the sliding friction exerted when the same box is pushed along the floor.

Encourage children to make their own explanations about the different amounts of friction caused in the two instances. Help them to become more adequate in the use of language to describe and interpret these experiences.

Fasten some rough sandpaper to a wooden board. Roll a toy car over the rough sandpaper. Now try to slide a small object over the sand-

paper. In which situation is there less friction? What interpretation do the children give of these experiences? Do they conclude that rolling objects do not rub against the surface upon which they are moving as much as do flat objects?

Using Energy to Move Things · It takes energy to move things. Place one or two books on a sheet of paper. Pull gently on the paper. Note that the books go along with the paper as long as you start the movement gently. Now jerk the paper quickly. It slides out from under the books. More force was needed to move the books quickly than to move the paper from under the books. Therefore, the paper moved rather than the books.

Observing Wear by Friction · Friction causes wear. Children have often seen applications of this statement. Talk over with them the fact that rubbing causes clothes to wear out. Bring articles to school and show that where friction was greatest, where there was more rubbing, as on the soles of shoes, at the elbows of sweaters, and on collar and cuff bands of clothing, there are signs of wear. Rubbing weakens the fibers of materials causing them to break and make a hole. What effect does an understanding of this fact have on the attitude of the children toward the care of their clothing?

One of the reasons we grease wagon wheels, some toys, engines, and other mechanical objects is to keep the moving parts from wearing. The grease placed where one part rubs another helps to lessen the friction between them and therefore to lessen the wear.

Ask the children to observe wear caused by friction at your school. For example, they can see the bits of chalk that are worn off when someone writes on the blackboard. They may notice that the lead

(graphite) of a pencil wears off as they write on paper. You may need to point out steps, stairs, and hallways that have been worn by many feet rubbing against the floor. Note also how some of the worn-off materials become dust in the air.

Feeling Heat from Friction · Friction makes heat. Have children examine the skin of their hands under large reading glasses to see the rough places on them. Do they see the connection between this roughness and the fact that when they rub their hands together hard, they become warm?

Rub a button, coin, or spoon against a woolen rug or coat. Friction causes the metal to become very warm. Perhaps a Boy Scout might demonstrate by rubbing sticks together how friction can cause enough heat to start a fire.

Evaluation

Evaluation continuously takes place when children and teachers really work together. There is usually some evaluation during planning as you make choices and decisions together. Are your children making progress in planning co-operatively with you? Do they need more opportunity to make choices and decisions with your guidance? If your children participate in planning their science experiences, you will no doubt see some growth along the lines suggested by the following observations:

Planning helps children to state problems and hypotheses and not to depend upon guessing.

Planning helps children to check their thinking through experimentation and careful observation.

Planning helps children to select and read material to verify their facts and opinions and to avoid gullibility.

Planning helps children to think through ways to carry out experiments, excursions, and other activities in such a way as to insure safety for the persons involved.

Planning together tends to encourage better relationships within a group because members take part in choices and decisions.

During the study of this selection did you observe children interpreting their experiences rather than just describing them? Did they reveal growth in explaining conditions or giving reasons for what they believed to be true? As the children give interpretations they have an opportunity to internalize what they see, hear, touch, taste, or smell. Thus there is greater depth of learning from their science experiences.

Did you see evidence that your children have improved their ideas of the large pattern of energy, as illustrated by the fact that it takes more energy to move some things than others; that rough things cause more

friction than smooth things; that there is less friction between rolling objects than between sliding objects; and that friction causes wear?

Bibliography

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 683–688. Ginn and Company, 1958.

Film

FRICTION. (YAF) 1 reel, b/w. Introduces the nature of friction as a restraining force in everyday life. Explains the ways in which we try to reduce friction and the ways we try to increase it when it is helpful.

Filmstrip

FRICTION AT WORK. (YAF) color.

X

Making Things Move

Children are curious about the movements of objects. They use their own energy to move about and to move objects. They use their own muscular energy to touch and to grasp objects, to pull and to push objects. They use their energy to do the work of turning, dropping, lifting, or winding objects. They do work when the energy of their muscles enables them to fly kites, whirl pin wheels, play with balloons, and perform tasks.

Children may have watched the wind move the wheel of a windmill or move sailboats. The wind is another source of energy for moving objects and it does work.

Children like to play with water, splash it, and watch objects on the surface float or sink. They enjoy watching their little boats move about on it. You can help them to become articulate about their new ideas of water, such as that it is a source of energy for moving objects, and that water does work when it moves objects.

Children wind springs in many kinds of toys with keys. They are curious, but often not articulate, about what makes these toys move. Sometimes they have felt keen disappointment when springs in their toys failed to work. They may be curious about springs and try to take a toy apart in order to see what they do. Do the children understand that the spring is a source of energy which makes things move?

Children can see that electricity moves things for them. They know that electricity does work. Children hear the whir of motors in mechanical objects all around them at home, at school, and in the community.

So far, the chief concern of children with atomic energy is in connection with the practice of air-raid drills, which they do with considerable poise and calmness. In time they will learn more about atomic energy for peaceful uses. It is not enough for them to see, to feel, and to hear in their firsthand experiences. Children must have opportunities to talk things over with you, to ask questions of each other, to check observations and experimentation by reading, to see relationships between facts, and to reach conclusions.

Science Meanings for Children

The following science meanings will help you to develop some understanding of the large patterns of energy and work:

Some kinds of energy make things move.
We know there is energy when we see things move.
People use their energy to move things.
They do work when they move things.
Springs can make some things move.
They do work when they make things move.
Electricity moves things. Electricity does work.
The wind moves things. When it moves things, it does work.
Water moves things. Water does work when it moves things.
Steam moves things. Steam does work when it moves something.
Gasoline moves many machines.
It does work when it moves things.
We find energy in different forms: wind, electricity, and others.

Information for the Teacher

People need energy to do work. A great source of energy used on our earth is the sun. There are many forms of energy. People harness energy, transform it (change it from one form to another), and put it to work.

Forms of Energy · A body able to work possesses energy. We usually think of energy in the form of something moving or doing work. A lump of coal has potential ability to produce motion. This is called potential energy. The energy of actual motion is called kinetic energy. But an object does not have to be in motion to possess energy.

Heat Energy · In sawing wood the saw becomes warm. When you rub your hands, they become warm. A nail becomes warm when you pull it from wood. Thus you know that when two substances are rubbed together, heat is produced. The amount of heat produced is in proportion to the amount of work done. Part of the energy used to rub is changed to heat. This heat is another form of energy. Fire also produces heat energy. Burning is a chemical action which produces heat and light. Both are forms of energy.

Muscular and Mechanical Energy · The energy of muscles is known as mechanical energy. This energy does work in the form of pushing, pulling, winding, lifting, dropping, or turning in some way. As you know, the energy of our muscles comes from the foods we eat.

Horses, llamas, camels, dogs, and oxen pull things for man. The work

they do is performed by muscular energy. Putting animals to work for man helped greatly in building various civilizations.

Most machines do work by means of energy in a mechanical form. They do not create the energy; they turn it into a useful form. For example, a gasoline engine can do work by using the energy from the

The community affords many opportunities for children to observe and interpret machines doing work.

burning gasoline. Many machines change the direction instead of the form of energy. For example, by pushing on the handle of a lawn mower, we cause the blades to whirl around. This round and round motion cuts the grass.

The Energy of Wind and of Falling Water · Wind is too irregular and unreliable to be useful as a source of energy in itself. It is important, however, for the fact that it brings rain and thus helps to distribute water over most of the earth's surface.

The energy of running water can be made to do work. Even in earlier times water did work by pushing the paddles of water wheels which turned mill wheels that ground grain. In more recent times the old-fashioned mill wheel has been developed into the modern water turbine. This adaptation of the old water wheel, or turbine, is now used to turn a generator which produces electricity.

Electrical and Chemical Energy · Electricity can be made to do work for us. Electricity can be changed to heat. It heats stoves and irons. It can produce light, as in electric lamps. It can produce motion, as in motors or bells. Other forms of energy, such as water and coal, can be changed into electricity.

Burning, a chemical change, releases heat. Heat also is a form of energy. Chemical changes such as those which take place in batteries or dry cells produce electrical energy. The energy released by the chemical change was stored in chemicals at some time in the past.

Atomic Energy · Children will hear much about atomic energy while they are using this book. If they discuss it, help them to develop a feeling of confidence in the future by pointing out that this new form of energy can be used for good. You will need to keep in mind that man has had difficulties with each new form of energy he has attempted to use. This was true when he harnessed the first horse to work for him, attempted to make steam turn the wheels of textile mills, and used gasoline to propel airplanes. In each case, however, he has been able to direct and develop these forces for the good of people.

Ways of Working with Children

Page 118 · Making Toys Move

Some kinds of energy make things move.
We know there is energy when we see things move.

Stating Problems About Toys · There are many ways to start the work with your children concerning energy. You might use some everyday situation around you, or you might wish to start with the illustration on page 118. Could you make use of your children's own toys and their observations? If the children wish to bring their toys to school, you will want to arrange a space to exhibit them.

During a discussion see if the children are aware of the source of energy that makes the toys move. If not, help them to state their problem in terms of a question, such as: What makes different kinds of toys move? Accept any level of the concept of energy and work for the time being but give the children an opportunity to develop their concepts.

Turn to the illustration on page 118 as a source of information. Read with the children the title of the whole chapter and the title of the selec-

tion on page 118. This page may help the children to state problems. Talk about the toys in the picture. About each toy, ask: What makes it move? Read page 118.

Could your children group the toys in the illustration, as well as those in their own exhibit, according to the source of energy that makes them move? The toys might be grouped with captions stating the source of energy required, such as toys we push and pull; toys run by air or wind; toys run by electricity; toys we wind; and others.

Page 119 · You Move Some Things

People use their energy to move things.
They do work when they move things.

Interpreting Situations · Is there a toy in your collection like Bill's shown on page 119? Note that Bill pushes the train, and that it stops when Bill stops pushing. Ask the children to read to check their comments. Discuss the fact that Bill does the work when he pushes, and that he does the work by using the muscles in his arms and legs. You may wish to take time for the children to feel each other's muscles while pushing something.

Note that in the second illustration Bill is pulling the wagon. Ask: When does the wagon stop? Read the second paragraph to find when the wagon stops. Discuss this sequence of ideas again: Bill is pulling the wagon; Bill uses the energy of his own muscles to do the work; and the wagon stops when Bill stops pulling.

Guide the study of the last illustration by asking: Who is working? What work is being done? What is moving? Read the conclusions in the last paragraph on page 119. All the children should have an opportunity to demonstrate and to describe the source of energy, that is, who is doing the work, and to generalize that making things move is work.

Page 120 · Springs Move Some Things

Springs make some things move.
Springs do work when they move things.

Stating Hypotheses · Guide the study of the toys in the illustration. Ask: What makes these toys move? Do we have toys in our collection that move like these? Encourage the children to give their own explanations.

Children are usually not very articulate about springs doing work. If you listen, you will very likely hear children making hypotheses, some of which may not be accurate. For example, they may make hypotheses, such as toy animals walk by magic, or the child pushes the train in the picture to make it move. Do your children notice the keys in the toys?

Suggest that they turn the keys on some of your winding toys and see what happens.

Refer to the train in the picture. Ask: What makes *this* train move? Does something in the train make it move? Encourage your children to make their own explanations.

Reading to Check Ideas · Whatever the hypotheses are, ask the children to read page 120 to check their accuracy. Are the children aware of the method they are using for getting truth and solving problems?

Experimenting with Springs · Could you take some old toys or old clocks apart and see the springs? Could you see a spring in different stages, as in the illustration at the bottom of page 120? Do your children state generalizations in the conversation, such as springs move things, and they do work when they move things?

Page 121 · What Makes the Train Move?

Electricity moves things.
Electricity does work.

Interpreting Sources of Energy · In studying this page you may wish to use a procedure similar to that suggested for page 120. You will note in the illustration and in the text the addition of tracks for the train. You may wish to bring in the concept of friction here. If your children have previously used the chapter on "Friction," how well do they see the relationship between the smooth surfaces of wheels and tracks? If it is not clear to them, you may wish to refer again to the chapter about friction.

Page 122 · The Wind Moves Things

The wind moves things.

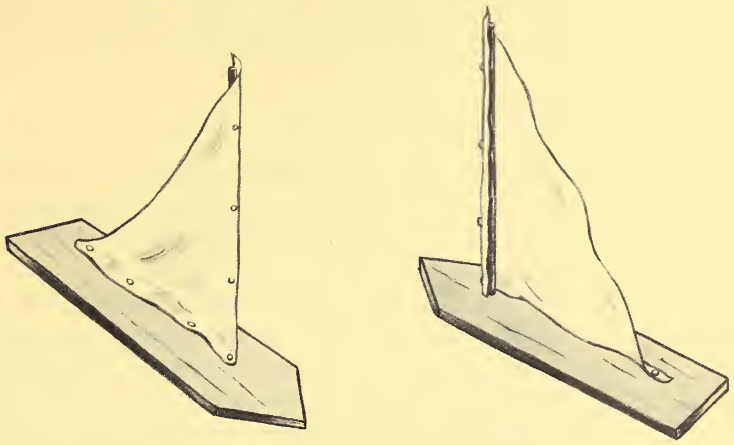
Using the Wind as a Source of Energy · You should be able to bring out in conversation all the ideas in the first paragraph. Ask: What is moving the things in the first picture? Now who can read the title? What is the wind moving? Here you see the drama of sudden changes in weather, such as that people are bending with the wind; that it pushes Bill and turns his pin wheel; that it blows dust, papers, trees, and clouds; and that a man's hat is blowing off. Can the children tell about their own experiences with wind as a source of energy that moved objects?

Examine the second illustration on page 122. Can the children check the accuracy of their comments by reading the last paragraph?

Perhaps you might wish the children to make their own sailboats. Watch for comments about friction as the construction work goes on.

If there is no body of water near you, you might help the children to

secure a large container for water. Use an electric fan to furnish the "wind" to sail their boats. Take precautions against accidents while using an electric fan in the classroom.



Page 123 · The Wind at Work

When the wind moves things, it does work.

Listening to Explanations · Do the children recognize the windmill? Do they know anything about its use long ago? How would a windmill help a farmer today? Do not hesitate to draw upon your own background for interesting facts about windmills. Has any child seen a windmill? Is there one near you that you could see working? Help the children to focus on the concepts of wind having energy to move things. When it moves things it does work.

Use the children's questions or these to guide their reading: How do farmers put wind to work? How do windmills do work? Take time to let the children discuss the question on page 123.

Pages 124–125 · Water Moves Things

Water moves things.

Seeing Water Move Things · Encourage the children to tell about their experiences of seeing water move things. They may tell about boats and other objects moving in the water, such as paper, twigs, small rocks, and sand. Do the children notice the narrow and the wider part of the brook in the illustration on page 124? Which boat moves fast? Which boat moves slowly?

Read to see if their comments agree with those in this selection. Is

there a brook near you where children might check their conclusions by observing their own boats moved by water?

On page 125 note the waterfall, that water seems to be moving fast, that it moves over and around the rocks, that it is strong enough to move things, and that water does work when it moves things. Should all the concepts not have been developed, read page 125 for more facts.

Page 126 · Water at Work

Water does work when it moves things.

Seeing the Force of Water · Help your children to get some understanding of the functions of the wires, powerhouse, dam, and force of water falling over the dam as shown in the illustration. Have the children seen a similar situation? Are they clear about the energy of the moving water? Ask: What does the water falling over the dam do? How does it help to make electricity? Help the children to see that the water turns big wheels around. Focus attention on the fact that it is the energy of the moving water that turns the wheels.

Reading for Information · Does your discussion of water at work at a dam and powerhouse seem vague? Do the children sense a sequence in details? Are there differences of opinion? Can they give reasons for what they say? Ask: How can we be sure? Suggest that they read to find out what makes electricity. Ask: How does electricity go from the powerhouse to other places?

Help the children to answer the last two questions on page 126. Of course, children of this age would not go into a detailed study of the generation of electricity. However, it would be helpful if they could see a powerhouse and have a general idea of the large machines that produce electricity, and that electricity comes to us from those machines through wires. See if you can find where the wires from a powerhouse come into your building.

Page 127 · Electricity Moves Things

Electricity moves things.
It does work when it moves things.

Observing Trains Move · Encourage the children to tell about watching trains. What kind of trains do they tell about? Do they know what source of power makes them move? Do the children see that electrical power or energy can make things move? What is the source of energy for trains near you? Could you visit a train to see for sure?

Study the illustration on page 127 with the children. Ask: How do you know electricity moves the train? Help the children to see the overhead wires and the trolleys at the tops of the cars that touch the wires.

Do the children see and discuss the smooth tracks and the big wheels? Ask: How do the tracks help the train to go fast? Discuss the fact that the tracks and wheels are very smooth and that the rolling friction between them is less than sliding friction would be. You may wish to reread appropriate selections from the preceding chapter on "Friction." However, the major focus here should be on the fact that electricity moves things, and that it does work when it moves things like this train.

Guide the reading by using the children's questions or your own comments or questions, such as: Find two reasons why the train goes fast. How does electricity get to the train?

Page 128 · Steam Moves Some Trains

Steam moves some things.
It does work when it moves things.

Checking Interpretations · Through discussion find out if the children have seen engines like the one in the illustration. You might wish to ask: What do you see in the illustration that makes you think this is a steam engine? The children may bring out that the fireman is shoveling coal into the firebox; the tender's water tank is receiving water; and the white cloud (which is not steam) is escaping from the lower part of the engine.

Help the children to read the title and the first paragraph to see if they brought out clearly all facts observable in the illustration.

Stating Problems and Hypotheses · Help the children to state the problem, such as: steam makes the engine move (hypothesis), or what makes this engine move? Preparation for reading the second paragraph in answer to the problem may need further questions, such as: Where is the water (in the engine)? What happens to the water (it is heated)? How does the boiling water change (into steam)? What work does the steam engine do?

Now check comments for accuracy by reading. The children should be able to follow and state in their own way the conclusions in the last two sentences on page 128.

Observing the Power of Steam · You should not count on all children understanding how strong steam is without an opportunity for some observation. Here is a simple experiment to help children check their verbal conclusion regarding the power of steam. Perhaps as a safety measure you might demonstrate this experiment and ask the children to watch.

Boil water in a teakettle over a hot plate. Listen to the sounds of the boiling water. Soon the steam will be strong enough to push the top of the kettle about. Children could probably give further evidence about the power of steam from observing their mothers cooking at home.

Perhaps you and your children might observe a steam engine at a railroad station near you. Note the coal or fuel oil which is used to heat the water. Does the engine's tender get water at your station? Can you see this activity? Can you see a fireman shoveling coal into a firebox? Do you see white clouds escaping from the lower part of the engine?

Page 129 · Gasoline Moves Things

Gasoline moves many machines.
Gasoline does work when it moves things.

Observing Machines · Go outdoors, if possible, to look for a variety of machines in your neighborhood. How many can the children see that use gasoline as a source of power? What kind of work do the machines do? Do the children see work being done which has another source of energy? What attitude do the children show toward machines?

Suggest that the children look at the illustration on page 129. Ask what makes these machines move. Most of these objects are machines that are within the everyday experiences of children. Encourage your children to apply to the machines in the illustration some of the concepts they have been learning, such as that some source of energy or power is needed to move machines, that machines do work when they move objects, and that machines do work for us.

A bulletin board provides a more fruitful opportunity to learn if it calls for organization and grouping to show relationships. The children might write their own captions for groups of pictures, such as "People Use Their Energy to Do Work," "Wind and Water Move Things," "Springs Move Things," "Electricity Does Work," or others.

Page 130 · What Makes These Things Move? — Page 131 · What Makes These Machines Do Work?

You may wish to use pages 130 and 131 as one way of evaluating the progress of your children. For discussion of "What Makes These Things Move?" four forms of energy are illustrated. Can your children make use also of their immediate past experiences in discussing the question? Do they understand the source of energy and the kind of work each source brings about? Do they state in their own words conclusions appropriate for their level of maturity?

Materials Needed

For experiences and experiments suggested in *Science Around You*:

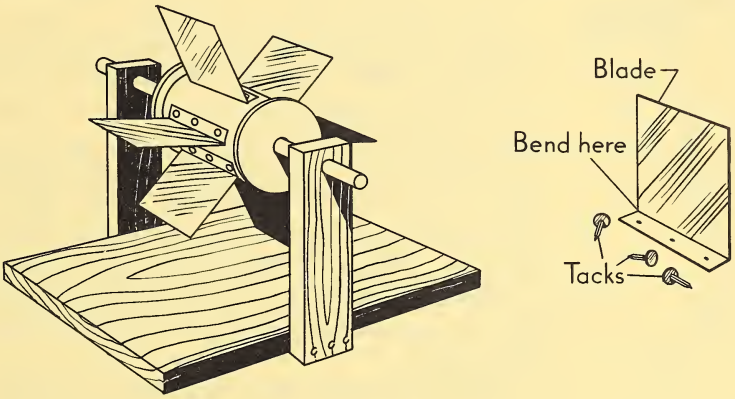
boats, toy
electric train, simple
sailboat materials: wood, cloth
springs from clocks or toys
toys to push or pull, to run by electricity, to sail, and to wind

For experiences and experiments suggested in this Manual:

electric fan
electric hot plate
kite materials: paper, rags, string, strips of wood
pyrex nursing bottle
stopper, or substitute
teakettle
water-wheel materials: glass tube or dowel stick for axle, spool, strips of copper or tin, tacks, wood for base

Further Experiences

Individual interests in making things move will vary among your children. There will be variations too in their need for further experience to make concepts more meaningful. Carrying out some of the following activities may help to meet the children's interests and needs.



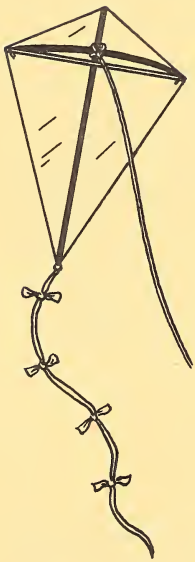
Making a Water Wheel · The moving force of water can turn a water wheel. For this experiment you will need a large spool, about five or six pieces of sheet copper or tin which can be cut from a tin can, small tacks, wood for a base, and a glass tube or a small dowel stick or pencil for the axle. Make the blades the shape shown in the diagram. Then tack the blades to the spool. Put the axle through the spool, and attach the completed wheel to a wooden base as illustrated. Children may need help in assembling this water wheel.

To demonstrate that moving water has force, have the children hold the water wheel under a faucet so that the water strikes and moves the blades. Explain that it is a similar force, or action, which turns a water wheel or water turbine.

Observing the Work of Water · Running water does work. If it is warm and children are dressed appropriately, perhaps you and your children can go outdoors during or after a heavy rain. Note how many small streams of water are running downhill carrying sand and mud. In the same way, gullies are made by larger streams of water carrying away greater amounts of sand and mud. The swiftly moving water shows its power. When water moves soil, it does work.

Seeing Steam Do Work · Steam can do work. As a safety measure the teacher should demonstrate this experience to children rather than let them do it. Fill a heated nursing bottle about one-quarter full of water. Place a stopper in it loosely. Then boil the water in the bottle by placing the bottle in a pan of water. Avoid pointing the mouth of the bottle toward anyone. As the water boils steam is formed. When there is not enough space in the bottle for all the steam, it pushes the stopper out very forcibly. Be sure the bottle is kept in a safe position.

Steam has the force to move things. It does work, for example, when it pushes the stopper out of the bottle or moves a steam engine.



Making a Kite · The force of wind and moving air makes a kite fly. Kites may be constructed by fastening two light strips of wood in the form of a cross about twenty-four inches by eighteen inches and covering them with paper. Then bend the shorter strip like a bow by tying a string to the ends and fastening it tautly. The long kite string should be fastened at the joint of the two strips. A streamer of rags fastened to the bottom point of the kite will give it stability.

When the children fly their kites they will feel the pull on the string. Do they understand that the pull is caused by the force of the wind and moving air?

Observing Various Mechanical Devices at School · Mechanical devices do work by means of electricity generated by the force of water. If possible, take your children to the basement or elsewhere in your building to see various mechanical devices. Discuss safety measures before going on the trip. Ask the custodian or someone else to go with you to tell the children what each device does. On the trip let the children see where the water is piped into the building and where waste water is piped out. Let the children see where electric wires come into the building and the location of the fuse box. What attitudes do the children reveal toward the machinery? Are any of them fearful? Do they seem interested in mechanical devices?

Evaluation

Since individuals vary so much in background and experience in a given area, it is quite natural to expect variations in growth. As a teacher,

you will be happy with whatever progress is made. You will know that a small amount of change in attitudes, behavior, or concept development for one individual may be extremely significant for him at that particular time.

Do you see growth in the ability of your children to make interpretations rather than merely describe events? Do they show a willingness to give reasons for their opinions? Do you see a difference in the attitude of the children toward machines? Is there more interest? Is there less fear of machinery? Do they make more things to test out their ideas? Do the children have improved ideas about energy in different forms, such as wind, water, electricity, and others? If you see changes along these lines, you may be sure that the children are making significant progress.

Bibliography

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 657–682, 753, 762–764. Ginn and Company, 1958.

For the Children

Elting, Mary. *Machines at Work*. Garden City Books, 1953. Children will enjoy selected excerpts and pictures about many kinds of machines that dig, hammer, and push.

Hoffman, Elaine. *More Friendly Helpers*. Melmont Publishers, 1954. Pictures and text about different kinds of machines.

Jauss, Anne Marie. *The River's Journey*. J. B. Lippincott Company, 1957. Excerpts may be read to children about the water moving things, how dams control the river, and power plants that utilize the water.

Leavitt, Jerome. *True Book of Tools for Building*. Childrens Press, Inc., 1955. Gives use of common tools such as the screwdriver, hammer, and drill. Discusses the care of tools as well as their safe use.

Schneider, Herman and Nina. *More Power to You*. William R. Scott, Inc., 1953. Excerpts may be read to the children to show what makes many things move. The book will be more useful to the teacher.

XI

Care of the Farm

The problems in the area of conservation are so acute that it will take years of education to prevent the misuse of our natural resources and other materials. Therefore, our youngest citizens need to develop a sensitivity to these problems around them. Help them to keep in mind that conservation means wise use of resources. A child is fortunate who has some adult who will walk with him into the out-of-doors and open up new avenues of thought.

In this chapter you will follow Jim and his father over the fields, into the woods, and to the brook on their farm. Their conversations reveal desirable attitudes toward the care of soil, domestic animals, woods, wildlife, and machines on their farm. Here is an adult giving explanations and interpretations to a child.

In *Science Around You* the authors have tried to reveal a wise use of the out-of-doors. On page 13 children picked up leaves from the ground instead of taking them from the tree. On page 14 they left the leaf buds outdoors. On page 15 they left seeds outdoors so that there could be new plants in the meadow next spring. On page 19 the butterfly chrysalis was left outdoors because the schoolroom was so warm that the butterfly might come out before the cold winter was over. You noticed that the terrarium on page 31 was stocked with common but plentiful plants rather than with scarce ones.

On page 100 your children may have read that Mary brought a turtle to school. The children tried to make a place for the turtle as much like its outdoor place as possible. After a day or two they took it back outdoors because "a good place for the turtle is the big woods."

You observed on page 108 that Mary left plants to grow outdoors where there were only a few. However, where there were many, she took a few plants to school for study. On page 141 you will find that Jim's father plants young trees as he cuts the large ones.

All of these situations are good practices for the care of natural resources. Children may see or participate in them. From such actions you may expect to find desirable behavior developing toward the care of many things.

Science Meanings for Children

The following science meanings will help you to develop some understanding of the large science patterns or principles, such as interrelationships, balance, variety, energy and work, and the adaptations made by living things:

Soil needs care. Plants help to hold the soil.
Horses help to do work. They need care.
Tractors help to do work. They need care.
Iron will rust when wet.
The woods make a good home for some animals.
Trees and leaves help to hold the soil.
Young trees should be planted when trees are cut.
Our country needs good farm land.

Information for the Teacher

It is important to see the relationship of living things to their physical environment. Wise use of our resources calls for a study of the principles involved in the struggle for existence, the balance of nature, and the interrelationships of life.

Soil: A Natural Resource of a Community

Kinds of Soil · Usually there is a wide variety of soils in a given community. Several factors influence the formation of soil. For example, different kinds of rock help to make a variety of soils. Even the same kind of rock may produce different kinds of soil depending on the climate and vegetation. Plants influence the soil, and soil, in turn, helps to determine the kind of vegetation found in a given place.

Sandstone is the rock from which sandy soil is formed. The fertility of sandy soil usually needs to be increased by the addition of organic materials.

Clay soil, on the other hand, is frequently more fertile originally because it is made from igneous rock, which usually contains more chemical elements. Many plants do not grow well in clay soil, however. When it is dry, the soil becomes hard and baked.

The best type of soil for agricultural purposes is loam, which is a mixture of sand and clay. It is easier to prepare sandy loam for planting and easier to work it after seedlings have developed. What kind of soil do you have around you? What is the story of soil in your community?

Soil Erosion · Soil erosion is a process that has been going on since the earth first had atmosphere. Erosion works on the surface of the

earth. In a long-time view erosion has been beneficial for some surfaces of the earth. It may have prevented formation of large areas of flatlands and water-soaked plains. Erosion has been most harmful where man has removed protective ground coverings.

In regions where the soil is powdery it blows easily when it is disturbed. Little whirlwinds, dents, and ripples can be seen. It is well to recall here that water too is responsible for erosion in some areas.

Forests: A Natural Resource of a Community

Forest Lands · Forest lands are developed by modern farmers. More and more farmers and lumbermen have a planned way for cutting and replanting trees. Do you see this practice around you? It is a well-known fact that soil will wash away when trees are removed and the land is left bare. An accumulation of soil through centuries of soil formation can wash away in a matter of weeks.

What story do the forests around you tell? Has any damage such as that often done by early settlers been overcome? Do forests contribute to the soil and water resources around you? Is the wildlife protected in your areas?

Windbreaks · Windbreaks have long been used around farmhouses in the prairie region. The government has been concerned with building a shelter belt from North Dakota near the Canadian border through the Great Plains and on into Texas. Do you see windbreaks and shelter belts near you? What kind of trees are used? Do they furnish protected places for wildlife? Would a windbreak near your school be advisable?

Water: A Natural Resource

Water for Plants and Animals · Plants and animals vary in the amount of water they need but all must have some water to exist. The amount and availability of water have an important effect upon the distribution of plants and animals.

For example, plants and animals found in a dense moist woods differ from those at the edge of open woods and fields. Living things in a valley may differ from those at the top of a dry sunny hill. Life in a marsh or swamp differs from pond life. Desert life is still another illustration of the adaptation of living things to available water supply.

Wildlife: A Natural Resource of a Community

Importance of Wildlife · Too frequently when people have come into a new area the wildlife found there has suffered and been neglected. Often

people have been unaware of the many benefits that come from this vital resource. For example, the fertility of the soil is greatly enhanced by plants and even the lowly earthworm. Birds help to keep insects in check. Skunks, hawks, snakes, and other animals help to keep rats, mice, and insects in balance. But when forests are cut down, birds, deer, and other animals often lose their homes. When swamps are drained, marsh-dwelling animals lose their natural homes. Loss of these animals to a community may appear insignificant until we realize that they help to maintain a balance of nature favorable to man.

What kinds of wildlife do you find in your community? Is a balance in wildlife maintained in your region? What is being done to prevent unwise use of wildlife? Plants and animals are interdependent. A variation in the conditions affecting the growth of one also influences the growth of the other.

Some plants and animals might rightfully be considered pests. But we need to be well informed about the value of plants and animals before deciding which ones of them should be destroyed. Even weeds have considerable value in certain places. They help to cover the soil of new road grades, untilled fields, and sites where natural vegetation has been removed. Weeds may be the first, or pioneer, plants to grow in a disturbed area, holding the soil for other kinds of vegetation, such as pine trees, which may flourish there later.

Ways of Working with Children

Pages 132–133 · Soil Needs Care

Soil needs care.
Plants help to hold the soil.

Examining Soil · Encourage your children to discuss why the plants in the picture seem to be growing well. Discuss conditions that help plants, such as rich soil, good drainage, warmth, and light. The children might compare the appearance of the soil in the picture with that of the soil around them. Do plants grow well near the school, in home gardens, or on farm lands? Is the soil sandy, rocky, or rich?

In studying soil around you, you will wish to avoid embarrassing children who come from places having poor soil. The point to remember is that the soil will be different in different places.

Another way to begin this study might be through your need for good soil for indoor gardens, flowerpots, or tree boxes, or for flower borders or rock gardens on the school grounds.

You might wish to help your children plan and study along the following lines: What kinds of soil do we need? How many kinds of

soil might we bring to school? Which is the best for our use? What makes good soil? What does good soil have in it? How does it look? How does it feel or smell?

You may wish to examine under a reading glass soils from a variety of places. Label the soils according to the places in which they were found, such as: soil from near a swamp, a hillside, the deep woods, the outer edge of the woods, a meadow, a cornfield, a garden, under a decaying log, or the bank of a brook. Notice the variations in the different soils, such as in the color and texture, the living things in them, the amount of moisture they contain, whether they are packed or loose, their smell, and whether they contain bits of rocks, leaves, or stems.

Reading About Soil · Help your children to see on page 133 that Jim and his father are examining the soil. Ask: What do you think they are saying about the soil? Is it fine or coarse soil? Is it good soil? Does water move the soil away? How does good soil feel when you rub it between your fingers? How do plants help soil?

Check the children's thinking by guiding their reading of page 133. You may wish to help the children see and tell how plants hold soil. Could you take a walk outdoors with your children to see where plants help to hold soil?

Page 134 · Horses Need Care

Horses help to do work.
They need care.

Visiting a Farm · Perhaps you live where you could go to a farm to see how the farmer uses and cares for his horses, tractors, or other machines. Try to see the kinds of work that the horses do. The work would, of course, vary with the seasons.

Other firsthand experiences the children might have at the farm are: seeing woods used by animals and their young, seeing trees and other plants that help to keep the soil from washing away, and observing how leaves help enrich the soil, and how young trees grow. You might prefer to arrange more than one trip in order that the children's purposes and experiences could be made more specific. The children may reveal their interpretations by painting pictures.

Checking Hypotheses · You might help your children to state what they expect to see during their visit to the farm. What care do they expect to see horses having? What work do they expect to see horses doing? You help the children to state hypotheses when you help them to state what they expect to see. Help the children check or verify their hypotheses as they observe in firsthand experiences and also by reading page 134.

Page 135 · Tractors Need Care

Tractors help to do work. They need care.

Caring for Machines · Have your children seen a machine like the tractor in the illustration? What kind of work have they seen tractors do? Do they know that iron is used in making tractors, and that things made of iron may rust when wet? What machines and tools can the children see around school? How are they cared for?

Note the sky conditions in the illustration. Ask the children what kind of weather seems likely to occur. Why is Jim's father driving the tractor into the barn? Could the children tell of similar personal experiences? Ask them to read the first paragraph to see if their ideas are in agreement with those in the selection.

Iron will rust when wet.

Experimenting with Rust · After your children read the last sentence in the first paragraph, you might guide their attention to the small illustration in the right margin. What do they expect will happen to the nails? You might ask: What does rust look like? How long does it take for rust to form? How can you be sure? Read the first two lines in the second paragraph to check steps in the experiment. This procedure is only suggestive.

Such a procedure as stating hypotheses, experimenting to test hypotheses, and checking observations by reading will help the children to make use of elements of the scientific method. They need guidance step by step in this kind of discussion and reading.

Interpreting What You See · The second illustration includes materials needed for an experiment to show rust forming on nails. What explanation for rusting do your children offer? Help them to try this experiment. How do your children interpret the experiment? Assist them in making interpretations by asking: How long does it take for rust to appear? What is the color of rust flakes? Can you use the nails easily after rust appears?

Giving Explanations · Use the question at the bottom of page 135. Can the children tell about having seen rust-prevention measures used on things made of iron? Look around the school for rusted objects and objects which have been painted or oiled to prevent rusting. Encourage the children to look at home, too. Do they know that keeping objects clean, dry, and sometimes oiled will help to prevent their rusting? Garden tools may be cleaned and rusting prevented by dipping them in a container of sand mixed well with oil.

Pages 136–137 · A Home for Animals

The woods make a good home for some animals.

Seeing Animals in Natural Habitats · Do the children see that the animals in the picture are in their natural habitats? Do they notice the young with the animals? Ask if they can think why some of these spots chosen make good homes for the animals and their young. Can the children tell when and where they have seen some of these animals? Can they tell about other animals that live in woods near them?

Their Babies
Rabbits
Mother Rabbit makes a nice warm nest for her babies.
Mother Rabbit uses some of her own fur to make it warm.
Baby rabbits do not have fur
Animals and Their Babies
Do all animals take care of their babies?
Do all animals lay eggs?
Do all animals drink their mothers milk?
Farm
Woods Ani

Children need guidance in developing responsibleness for the environment.

Guiding Reading · In such a discussion do some members of the group disagree with one another? Do they give reasons for their beliefs and opinions? Are they willing to read pages 136 and 137 to see if there are facts which support their ideas? Finding the answers to children's questions, conflicting points, or your own questions can become the purposes that guide the first reading of these pages.

Page 138 · The Woods Help

Trees help to hold soil.

Observing Value of Trees · Help your children to focus their conversation on the woods at the top of the hill as they study the illustration. Ask: Where on the farm are the woods in the illustration? What do you think Jim and his father are saying about their woods? How do

you think the woods help their farm? Does the soil in the woods wash away? Use the children's comments or questions to guide the reading.

Could you visit a wooded spot near you? Could you see how the trees prevent the soil from washing away? Who takes care of the wooded area? Was your region heavily wooded when it belonged to the Indians?

Unless an understanding of the value of trees is developed with children, they are likely to take the trees around them for granted. Many of the trees may have been there when they were born. Children do not always realize that trees are plants, and that they are alive and growing just as the children themselves are living and growing.

After discussion your children might wish to make a chart showing the value of trees. Your children may think of values in addition to the following: forests supply us with wood to burn; wood is used for buildings; growing trees give us fruits and nuts; woods make a good place for picnics and hikes; they make the landscape beautiful; they make a home for some animals; and trees as well as other plants help to hold the soil. The children might make large pictures illustrating these or other ideas.

Recording Observations · If possible, walk through the woods or a park or look at trees on your school grounds to see how the roots hold the soil. Record the facts that you observe for an experience reading chart. The children should help compose the sentences for this record. They may prefer to make a picture record of this experience.

Pages 139–140 · The Leaves Help

Leaves help to hold the soil.

Making Interpretations · You may wish to help the children note the cover of leaves on the ground in the illustration on page 139. Contrast the old dark leaves you see here with the brightly colored leaves that have just fallen from the trees in the chapter on "Autumn." Ask: How would you expect the leaves in Jim's woods to look and feel? You might wish to record the children's hypotheses.

Could you help the children to be sure about their hypotheses by going outdoors to a spot where leaves cover the ground? What color are the leaves on top? Contrast the leaves on top with those beneath. How does the soil feel under the leaves?

The children might look under the leaves to see that they keep the soil from drying out. Plants grow better because of this moisture. Note also that the leaves have helped to hold the soil and prevent its washing away. Be sure to replace the leaves so that they can continue to keep the soil moist and in place. Now suggest that the children read to see how their conclusions compare with those stated on page 139.

Leaves help some plants to live through the winter.

Discussion and Reading · On page 140 note in the illustration how leaves seem dry and are breaking up. What words do your children use to describe this process? Discuss how the decaying leaves help plants. Observe leaves decaying in your vicinity. Examine the results of the decaying process of leaves under a reading glass. Do decayed leaves protect plants near you?

Those children who live in places where it snows in winter or early spring might look for plants whose roots have lived under snow. Then watch these particular plants as spring comes.

Compare the explanations your children give with the facts on page 140. Do your children accept these facts?

Page 141 · Young Trees Grow

Young trees should be planted when trees are cut.

Planting Young Trees · Help your children to focus on the young trees in the illustration. What do they think Jim and his father are discussing? What clues do they see in the illustration? Help your children to see Jim standing near a young tree about his height; many little pines and other trees growing in the woods; the stump of a tree that has been cut; and the trees as a part of the farm.

Help the children to question how the young trees got there. There may be a difference of opinion. Then read page 141 to find out for sure.

Include in the discussion such questions as: Do you see places where young trees might be planted? Is there a place on your school grounds where young trees should be planted? Do you know farmers who plant young trees when they cut the old ones?

Page 142 · Soil Helps the Farm

Our country needs good farm land.

Finding Out About Soil · Encourage your children to express their ideas as to why this might be a farm with good soil. They might include the following: plants are growing; it does not look rocky; the color of the soil is good; and the soil probably does not wash away.

Children who live on farms might compare the soil on Jim's farm with the soil around them. Help the children to feel a pride in farm lands, to see how important it is for their country to have good soil and good farm lands, and to understand that the farmers help many people by growing food and many raw materials needed for manufacturing.

Page 143 · Watching Plants and Soil

Reviewing · You may wish to use page 143 for review purposes and for reaching conclusions.

Materials Needed

For experiences and experiments suggested in *Science Around You:*

glass for water
iron nails
reading glasses

For experiences and experiments suggested in this Manual:

containers for plants
containers for soil
grass seed
rocks, small
soil of different kinds
tree seedlings
trowel or shovel

Further Experiences

You may wish to use some of the following experiences for your children in addition to those suggested in the last chapter of *Science Around You.*

Seeing How Leaves Help · See how trees or other plants help to keep the soil from washing away. If it is warm, take the children to a park or woods while it is raining. See how the leaves on the ground act as a sponge and prevent water from running off. Have the children study the leaf mold. Make sure they leave the woods in as good condition as it was when they came.

During the same trip you might take the children to a place where there are no leaves on the ground so they can see that where there is no cover the water runs along rapidly, carrying soil with it. Help the children to summarize their findings in such a statement as: trees and other plants help to keep the soil from washing away.

Seeing Some Value in Weeds · See how weeds have value in many places. Take a walk over the school grounds, a park, or a field. Look to see where weeds are actually helping to hold the soil. Ask the children to consider what would happen if they were removed. Discuss the advisability of making a plan to care for a spot before removing the weeds.

Preventing Soil from Washing Away · See how trees help to prevent soil from washing away. If possible, take a walk in a wooded area to see trees in various stages of growth including a tiny seedling, a tree with a few years' growth, and a tree of full maturity. Encourage your children to tell of places where young trees are planted or allowed to grow.

Try to find a spot showing the natural succession of plants, such as weeds, larger grasses, seedlings, and finally where mature trees dominate the plant life.

Could you plant some young trees on your school grounds? Ask the children to help find out what kind of trees will grow well in the place where they are needed. Will the trees need much water? How long do

the children think it will take the trees to grow? How much do they expect them to grow each year? Many local and state agencies provide young trees for people who wish to plant them. Do you have such an agency near you?

Experimenting · See how grass helps to keep soil from washing away. Place a few rocks in the bottom of a container to provide drainage. Then place a mound of soil over the rocks and plant grass seed. If kept damp for a few days, the seed will sprout. After the grass has established a good root growth, pour water over the mound to show how a cover of plants will help to keep the soil from being washed away.

If at the same time you prepare a mound without any grass on it, the children can see that when water is poured on this, the soil washes away, making gullies.

Finding Living Things in Soil · See how good soil may have living things in it. Try to secure a few little plots of soil about five or six inches square. The plots should be lifted out at about the same depth. Try to get soil from a variety of places.

Before the children remove the plots of soil, discuss the need to prevent soil erosion by placing rocks, leaves, or other matter in the place from which they take their soil. Ask them to be sure to leave the ground in as good condition or better than they found it.

Examine the lifted soil plots with reading glasses. You may see that plots from different places have different living things in them. In one sample remove all the living things. Place these in a warm place and keep them moist for a few days. Although these things seemed not to be alive in the soil, you may see that insect eggs and seeds of plants will start developing. As living matter decays it helps to enrich the soil.

Evaluation

This chapter has suggested ways of developing several elements of the scientific method discussed on page 6. As your children engage in these experiences note their patterns of behavior along the following lines: Do you see individuals sensing and stating problems or questions? Do individuals now state their own hypotheses? Do they suggest ways of testing hypotheses by experimenting, observing, and reading? Do they state conclusions? Are they willing to check conclusions by reading authentic materials, by further observation, or experimentation? You should not expect the same amount of progress from every child. In one individual a little change may be very significant.

Try to think of conservation as a kind of desirable behavior. Do your children feel a responsibility for the environment? What is their attitude

toward removing things from the out-of-doors? How do they care for their own clothing? Do they waste food? Are they wasteful of paper, pencils, or other materials? Do they destroy materials? Do they throw papers about while on an instructional trip? Do they care for tools and equipment? It is through watching behavior that one can tell whether or not a child is really learning wise use of the environment.

Bibliography

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 286–310. Ginn and Company, 1958.

Osborn, Fairfield. *Our Plundered Planet.* Little, Brown and Company, 1948.

For the Children

Blough, Glenn O. *Lookout for the Forest.* Whittlesey House, 1955. A story about a forest farmer, a lookout tower, a firebreak, and other facts about conservation.

Fenton, Carroll and Mildred. *The Land We Live On.* Doubleday & Company, Inc., 1944. The illustrations and excerpts about land, water, trees, and conservation will be useful.

Goudey, Alice E. *Here Come the Deer!* Charles Scribner's Sons, 1955. The story of deer families living in woods may be read to children.

Ipcar, Dahlov. *Animal Hide and Seek.* E. M. Hale and Company, 1957. Has information about some common animals in the woods.

Jauss, Anne Marie. *The River's Journey.* J. B. Lippincott Company, 1957. Excerpts may be read to children about the living things in the river and on the banks and how the roots of trees help to control erosion.

Parker, Bertha M. *Saving Our Wild Life.* Row, Peterson & Company, 1944. Selections about the wise use of plant and animal life may be read and discussed with children.

Paull, Grace. *Come to the Country.* Abelard-Schuman, Limited, 1956. Gives a simple interpretation of outdoor life in the country.

Smith, F. C. *The First Book of Conservation.* Franklin Watts, Inc., 1954. About interrelationships of water, forests, wildlife, plants, and soil, and ways in which man is conserving natural resources.

Films

OUR ANIMAL NEIGHBORS. (Cor) 1 reel, b/w and color. Some common animals shown are the gray squirrel, cottontail rabbit, gopher, deer, meadow mouse, mole, and bat.

WHAT IS SOIL? (IF) 1 reel, b/w. Shows that soil is essential to all living things and that they in turn contribute to the formation of soil.

WONDERS IN YOUR OWN BACKYARD. (C-W) 1 reel, b/w and color. A boy and girl find a worm, spider, millepede, sow bug, and snail. Film reveals some of the conditions under which they live.

Filmstrip

CONSERVATION FOR BEGINNERS. (SVE) 6 filmstrips, color.

Appendix

Materials and Equipment List

These materials needed for the experiences suggested in *Science Around You* may be secured within the school, from the home, or at local stores in your community.

Aquarium with cover
Balls
Bottle, quart
Box, large wooden
Broomsticks
Bulbs, onion or narcissus
Button
Cages for small animals
Candles
Clock
Cloth for making shadows
Cloth scraps of silk and wool
Clothespins
Dishes, deep and shallow, pyrex
Drum
Dry cells, 1 or 2
Electric bell
Electric hot plate
Flashlight
Flowerpots, porous
Gardening tools
Glass, 4″ × 4″
Glasses for water
Globe, with axis
Kites
Nails
Paints, cold-water
Pan, shallow
Paper box
Paper for painting
Pinwheels
Pitcher
Pyrex nursing bottle
Reading glasses
Sailboat, toy
Sandpaper
Saw
Screened box
Seeds: bean, radish, Lima-bean
Springs
String
Switch, knife or push-button
Tablespoon
Tea strainer
Teakettle
Thermometer
Tin cup
Toys: winding, wheeled, floating
Wheels
Whistle
Wire, insulated copper, #22 recommended
Wrapping paper

Equipment and Supply Houses

Bauer Thermometer Company, 332 West 21st Street, New York City. Thermometers.

Central Scientific Company, 1700 Irving Park Boulevard, Chicago, Illinois; 79 Amherst Street, Cambridge A Station, Boston, Massachusetts; 237 Sheffield Street, Mountainside, New Jersey. General equipment: magnetism, heat, light, hand lenses and reading glasses, copper wire, tuning forks.

General Biological Supply House, 8200 South Hoyne Avenue, Chicago, Illinois. Aquarium and terrarium supplies, living and preserved materials, charts, etc.

A. J. Nystrom and Company, 3333 Elston Avenue, Chicago 18, Illinois. Globes and atlases.

Peripole Products, 2917 Avenue R, Brooklyn, New York. Skin heads for drums.

Rand McNally & Company, P.O. Box 7600, Chicago 80, Illinois. Globes and atlases.

Directory of Publishers

ABELARD-SCHUMAN, LIMITED, 404 Fourth Avenue, New York 16, New York.

WM. C. BROWN COMPANY, 215 West Ninth Street, Dubuque, Iowa.

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DOUBLEDAY & COMPANY, INC., 575 Madison Avenue, New York 22, New York.

THE DRYDEN PRESS, 110 West 57th Street, New York 19, New York.

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GARDEN CITY BOOKS, Garden City, New York.

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THE MACMILLAN COMPANY, 60 Fifth Avenue, New York 11, New York.

MELMONT PUBLISHERS. Books distributed by Carl J. Leibel, Inc., 1736 South Hatcher Avenue, Puente, California.

WILLIAM MORROW AND COMPANY, INC., 425 Fourth Avenue, New York 16, New York.

OXFORD UNIVERSITY PRESS, INC., 114 Fifth Avenue, New York 11, New York.

RANDOM HOUSE, INC., 457 Madison Avenue, New York 22, New York.

ROW, PETERSON & COMPANY, 1911 Ridge Avenue, Evanston, Illinois.

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THE VIKING PRESS, 625 Madison Avenue, New York 22, New York.

FRANKLIN WATTS, INC., 699 Madison Avenue, New York 21, New York.

WHITTLESEY HOUSE (McGraw-Hill Book Company, Inc.), 330 West 42nd Street, New York 36, New York.

Film and Filmstrip Distributors

AlF	Almanac Films, Inc., 516 Fifth Avenue, New York 18, New York.
Birad	Birad Corporation, 35 West 53rd Street, New York 19, New York.
CurrF	Curriculum Films. Distributed by American Educational Projections Corporation, 1319 Vine Street, Philadelphia, Pennsylvania.
C–W	Churchill-Wexler Film Productions, 801 North Seward Street, Los Angeles 38, California.
Cor	Coronet Films, Coronet Building, Chicago 1, Illinois.

EBF Encyclopaedia Britannica Films, Inc., 1150 Wilmette Avenue, Wilmette, Illinois; 5625 Hollywood Boulevard, Hollywood 28, California; 7250 MacArthur Boulevard, Oakland, California; 277 Pharr Road, N.E., Atlanta, Georgia; 161 Massachusetts Avenue, Boston 15, Massachusetts; 4902 Argyle Street, Dearborn, Michigan; 6421 Park Avenue, Minneapolis 23, Minnesota; 202 East 44th Street, New York 17, New York; 463 West Main Street, Kent, Ohio; 2129 Northeast Broadway, Portland, Oregon; 1414 Dragon Street, Dallas, Texas.

IF Instructional Films, Inc. See addresses listed under Encyclopaedia Britannica Films, Inc.

SVE Society for Visual Education, Inc., 1345 West Diversey Parkway, Chicago 14, Illinois.

YAF Young America Films, Inc., 18 East 41st Street, New York 17, New York.

National Film Rental Agencies

Association Films, Inc., 347 Madison Avenue, New York 17, New York; 799 Stevenson Street, San Francisco, California; 561 Hillgrove Avenue, La Grange, Illinois; Broad at Elm, Ridgefield, New Jersey; 1108 Jackson Street, Dallas 2, Texas.

Brandon Films, Inc., 200 West 57th Street, New York 19, New York.

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